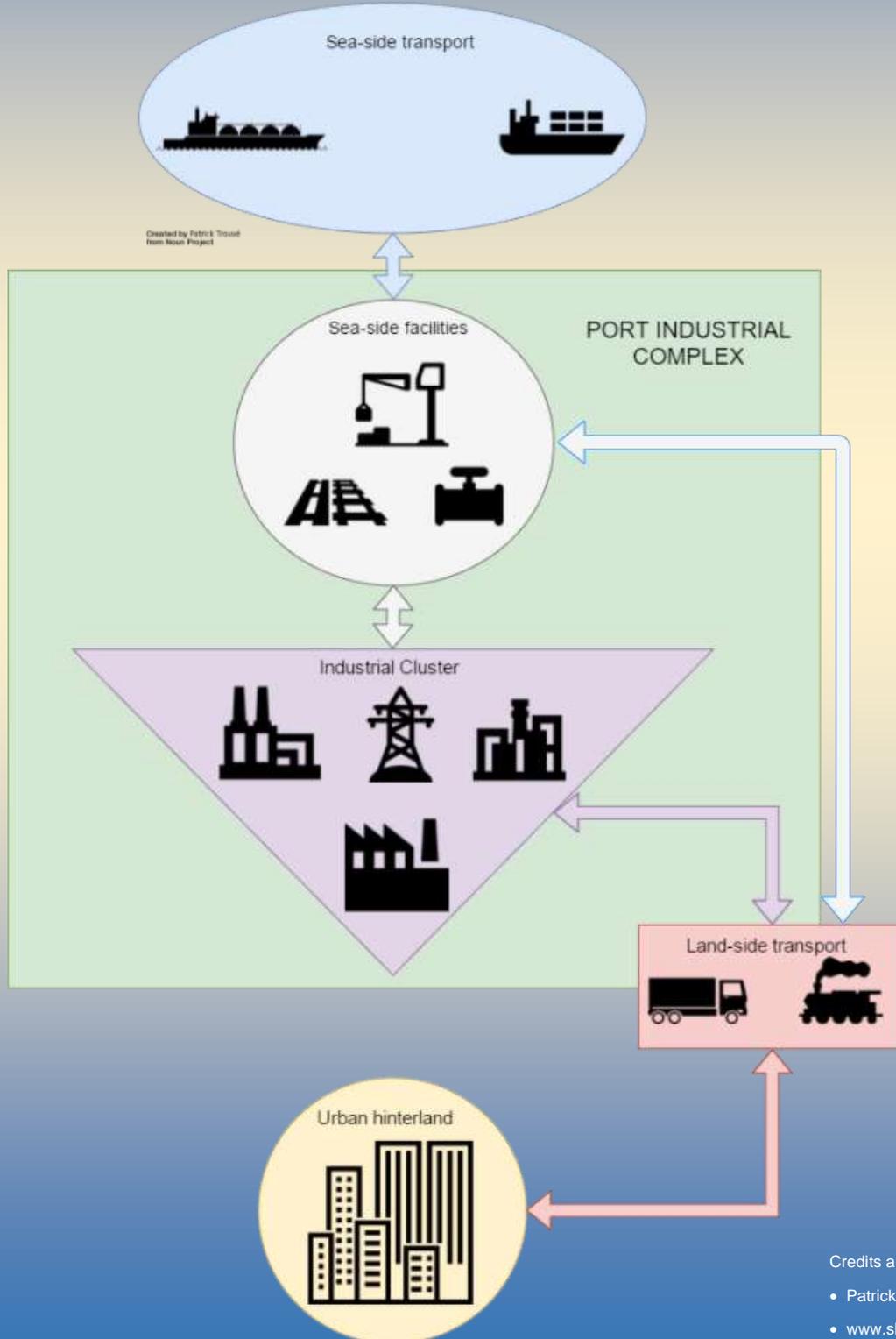


# Planning an Adaptable Port

## A Study of Port of Kuala Tanjung

### CIE 5060-09 MSc Thesis Final Report



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CIE5060-09 MSc Thesis  
Planning an Adaptable Port  
A Study of Port of Kuala Tanjung

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# Preface

“...Indeed, Allah will not change the condition of a people until they change what is in themselves...” (The Quran, 13:11)

Being an archipelagic country, Indonesia government has always tried to develop the nation's maritime capabilities. However, until now Indonesia has not reach its full potential as a maritime nation. Lately, the “Tol Laut Program” was initiated by the latest president, again to help Indonesia reach its full potential. Port of Kuala Tanjung, in this regard, play a major role for the success of the program. This brings me the motivation to asses the Port in a comprehensive way, thereby resulting in this thesis. Just as the verse in the holy Qur'an above, this thesis is a way for me to help ensure the development of Port of Kuala Tanjung to be successful, by involving deeply into the study of the project itself. I hope this small contribution would therefore help the “Tol Laut Program” to be successful in the long run, which in turn helps Indonesia in reaching its full potential as a maritime nation.

*Alhamdulillah*, all praise to Allah the almighty God, I finally be able to finish this thesis. This report is the embodiement of efforts, thoughts, and dedication which I have done for the previous eight months. In this early paragraph, I would like to thank the Lembaga Pengelola Dana Pendidikan (LPDP) for providing a full scholarship for my two years master degree in TU Delft. Naturally, I will not be able to finish this thesis on my own. Therefore, I would like to mention the parties to which I owe my thanks to.

First of all, I would like to express my deep gratitude towards all personnel whom directly assist me in completing this thesis. The graduation committee, Prof. Tiedo for his wisdom in directing me in to the right direction, Dr. Poonam for the detailed discussions and her patience in assessing my report, Ir. Rene for providing me chance to take this topic as a study and for the meaningful discussion regarding the latest development in port industries, and Dr. Jules for guiding me to see my research in a more comprehensive way. Then for the experts in PoRA whom directly involved in this thesis, Arthur for your friendliness, Carlos for your treats, Wouter for your assistance, Marc. A for your experience, Kees for your time, Edwin for your perspective. And special thanks to Mrs. Elly and Mrs. Inge for their vital role in scheduling meetings with the committees.

Next, I would like to thank for my cherrised Papa Yudi, Mama Ira, Mas Erick, Dek Chaya for their continuous support. My girlfriend Annisa IU for her care. My friends from LPDP PK-35 for their jokes and free meals. Colleagues in PoRA, Liontin for making PoRINT feels like home, Jasper for the jokes (good ones) , Dunna for the insights on softskills, Marc. E for the “Selamat Pagi” its makes really make me feels happy, Brenda for the study on people, Reyer for the help on container terminals, and Roland for the short talks. My friends from Trident especially Kenanga Mewangi group for their occasional jokes. And all other parties that supports me along the way, I am sorry to mention you, since I would not be able to mention everyone.

And for the reader of this report. Thank you for your interest in the result and topic of my study. I look forward for a fruitful discussion from you. Please do not hesitate to contact me at [andre.prakoso08@gmail.com](mailto:andre.prakoso08@gmail.com) for a discussion. I will always try to devote my attention into further developing the study contained in this thesis. Lastly, thank you TU Delft for everything.

Andre Prakoso

Delft, 23 October 2017

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# Summary

In an effort to become the world maritime axis, the Indonesia government has launched the “Tol Laut Program.” This program consists of integrated planning of all maritime-related industries such as shipping yard, shipping line, and ports. In the context of ports in “Tol Laut Program,” the Indonesian government has determined 24 strategic ports to be developed, which are located across the Indonesian archipelago. These ports are classified as either international hub (2 ports), national hub (3 ports), or feeder ports (19 ports). The international hub ports will act as a gateway which connects Indonesia with the international shipping route. The shipping of goods the within Indonesian waters will be accommodated by the national hub and feeder ports. The Port of Kuala Tanjung (PoKT) in the North Sumatera province, Sumatera island, is planned to be the Indonesia’s international hub port, along with Port of Bitung in Sulawesi Island. The development of the PoKT will be carried out by Pelindo 1, an Indonesian state owned port company, together with Port of Rotterdam Authority (PoRA) in the form of a Joint Venture (JV). During its development, the PoKT will face three major challenges:

- Negative Net Present Value (NPV)

Being a greenfield port, the PoKT will require a significant amount of capital expenditure (CAPEX) to build its basic infrastructures before reaching maturity (i.e., breakwaters, roads, and utilities). Since both Pelindo 1 and PoRA have agreed on using the landlord port governance model in managing the port, the PoKT will mainly have two sources of income, land lease fees, and port dues. The total of these incomes was projected to provide a slow return on investment (ROI) for the PoKT when combined with the need to pay for future Operation Expenditures (OPEX). As a result, the PoKT will have a negative NPV when analysed using a discounted case flow (DCF) business case. A negative NPV will make the PoKT **unattractive** for investors and potential tenants.

- Uncertain and Disruptive developments affecting ports worldwide enabled by digitalization, energy transition and continuous growth of emerging economies.

Port development projects are considered to be a long-term investment. Most ports are designed for a 30 – 50 years lifetime with the payback period of ~20 years after they are operational. Considering the long-term nature of port projects, the future developments in the port industry will become an essential factor in determining the success of PoKT. Failure in predicting or reacting towards the global port developments might result in loss in competition with the neighboring ports in the long term.

Due to digitalization and increased connectivity, the developments affecting ports worldwide have become increasingly more dynamic. On top of that, the global energy transition from fossil based fuel towards renewable energies will affect the way port industries operate. Moreover, the continuous growth of emerging economies will shift the global cargo flow. As a result, ports worldwide (including PoKT) will face a more **uncertain future than ever**.

- **Meeting The United Nations Sustainable Development Goals (UN-SDG)**

Due to its scale, the PoKT development will affect multiple aspects of the local inhabitant’s live significantly for a better or worse. To ensure its development would be beneficial and sustainable towards the local communities, the PoKT should be developed in accordance to the UN-SDG. By doing so, the added value created by the development of the PoKT can be augmented, and a government support for the project to make the project’s NPV positive can be justified. In the case of the PoKT, the UN-SDG number 8 (decent work and economic growth), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), 14 and 15 (life below water and on land) are the most relevant to be met. It should be noted that the different interest of the stakeholders are already considered in the UN-SDG number 11 (sustainable cities and communities).

To be able to cope with the major challenges mentioned above, especially to face the uncertain future, the PoKT requires a sustainable and adaptive masterplan. This study is dedicated to developing such a masterplan for Port of Kuala Tanjung and developing a detailed layout for the first phase, by applying the Adaptive Port Planning (APP) Framework (Taneja, 2013). The APP framework is designed to carry out port planning under uncertainties. The objective of this study is to not only devise a long-term strategy for the PoKT but also to come up with the first step solutions in how to develop the PoKT. Therefore, a comprehensive approach in developing the first phase layout of the PoKT has been adopted, ranging from technical, financial, stakeholder management, and commercial fields. In developing the PoKT adaptive masterplan, the United Nations Sustainable Development Goals (UN-SDG) has been referred as the primary guiding principle of the port planning.

The APP process is summarised as follows: **First**, an analysis of current and future uncertain developments that are relevant for the ports worldwide has been conducted. These developments were identified by using literature review and expert interviews with PoRA experts. Once identified, the developments were prioritized according to their importance for PoKT or other similar projects (greenfield joint venture port project located in an at least 60 Million populated hinterland). Four major developments have been identified and used as the main consideration in developing future scenarios for the PoKT masterplan and 1st phase layout. These scenarios were developed around two key uncertainties, which is the North Sumatera province economic growth and protectiveness level. The protectiveness level is defined as the level of a region internationalization, if it is high, than it means the region would apply a protective policy which secludes itself from the outsiders participation. There has been four developed scenarios with the “Sociable Oasis” being the most optimistic one. It should be noted that the level of importance of each developments towards the PoKT project will continuously change depending on the stage of the project development (planning, construction, operation, or redevelopment stage). Currently, the project is in its planning stage. The major uncertain developments are listed as follows:

- Top four:
  - Multi-national company joint ventures
  - Dynamics of relevant government support
  - Relationship with neighbouring ports
  - Dynamics of land acquisition process
- Medium priority:
  - Distinctive local regulation
  - Special economic zone
  - Dynamics of international standards
- Low priority:
  - Port related technology development
  - Consolidation of shipping lines

**Next**, an adaptive masterplan with a period of interest of 30 years has been developed based on the existing the masterplan that is developed by the PoRA on May 2017. The PoKT adaptive masterplan was designed to remain valid under various scenarios for the next 30 years. In order to achieve this, adaptive elements were embedded into the PoKT physical infrastructure, operational and management; and product and services, while taking into account the relevant uncertainties. As for the layout, sectoral approach has been adopted with a recommendation to develop the port westward of the 1<sup>st</sup> phase development. This recommendation is based on the cost saving by postponing river diversion which is located on east side of the port. The masterplan itself should also be reassessed every five years on the basis of new information, to maintain its accuracy and keep it relevant with the existing condition. This approach would result in a comprehensive and adaptable masterplan that is **able to withstand an uncertain future**.

The final realization of the PoKT would depend on the development of the first stages of the PoKT development, especially the choice of the 1<sup>st</sup> industrial tenant. This is a result of developing PoKT as an industrial port, instead of a gateway or transshipment port for the PoKT, a choice made by the JV beforehand.

**Finally**, the 1st phase layout of the PoKT development has been designed, based on the layout which is drafted by the PoRA team on the mid 2017. The improvements for the newly designed 1<sup>st</sup> phase layout are as follows:

1. Incorporating self-sustaining capability: The self-sustaining capability implies that the PoKT 1st phase layout can gain more revenue than its expenditures (both CAPEX and OPEX) without any dependence on the next stage of development while adding significant added value to the neighboring region
2. Incorporating catalysing effect: The catalyzing-effect, in infrastructure context, implies that the 1st phase of the port either creates the environment of the development of next phase or avoids obstructing future construction developments, thereby enabling faster and cheaper construction work and enables clusters to develop at the next phase. In a commercial context, a catalyzing effect means that the 1st phase of the Port will consistently generate a good financial portfolio to attract potential investors and future tenants in the industrial port complex

Both properties above are achieved by applying a port industrial cluster circular economy model. By placing similar industries within the port industrial cluster, the PoKT will attract future tenants to take advantage for its shared facilities. The industrial tenants would also provide the PoKT with a more stable cargo flow to support their industrial activities. Therefore a more robust 1<sup>st</sup> phase port layout has been produced.

The evaluation of the PoKT 1st phase layout(s) with respect to its financial, environment and social feasibility has been conducted through a business case and a qualitative assessment for the relevant UN-SDG. Layouts based on Metals (Alloy), Petrochemical, and Bio-based clusters are prepared for the 1st phase development of the PoKT. Based on the assessments, an Alloy industrial cluster proved to be the best alternative to kick-start the development of the PoKT as compared to the bio-based and petrochemical cluster. A combination of a dry bulk terminal, a cement and electricity plant, together with the required basic infrastructures and utilities, are identified to be the bare minimum necessities for the port to be operational in its 1st phase of development. Through this approach PoKT masterplan tries to develop in harmony with **the UN-SDG's**.

In conclusion, this study has improved the PoKT masterplan, and 1st phase layout as to its adaptivity, robustness, financial feasibility and the generated added values towards the surrounding region. By postponing the construction of the breakwater, the net present value (NPV) of the project has been increased by 48%, from -136 Million USD to – 70.16 Million USD in the best case scenario. According to this study, the PoKT project **would never be commercially feasible by itself without external support**. Due to the greenfield nature of the project, there would be significant risk imposed on the potential private investor, thereby making them reluctant to invest in the project in this early stage of development. Therefore, government financial support in the form of either capital injection, grants, taxation, contract offtakes or another type of supports is required. Other than improving its financial feasibility, this study has also promoted the added value which PoKT could bring to the North Sumatera region and Indonesia as an international hub port. In doing so, the UN-SDG number 8 (decent work and economic growth), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), 14 and 15 (life below water and on land), has been referred as the filter to identify and stimulate the added values generated by the construction of the port.

# List of Abbreviations

JV	: Joint Venture
PoRA	: Port of Rotterdam Authority
PoKT	: Port of Kuala Tanjung
Pelindo	: <i>Pelabuhan Indonesia</i> (Indonesia Port Cooperation)
UN-SDG	: United Nations Sustainable Development Goals
DCF	: Discounted Cash Flows
APP	: Adaptive Port Planning
NPV	: Net Present Value
WACC	: Weighted Average Cost of Capital
OPEX	: Operational Expenditures
CAPEX	: Capital Expenditures
MW	: Mega Watts
TEU	: Twenty foot Equivalent Unit
MMT	: Million Metric Tonnes
MPT	: Multi Purpose Terminal
ROI	: Return On Investment
FCF	: Future Cash Flow
IRR	: Internal Rate of Return
FGD	: Focus Group Discussion
SEZ	: Special Economic Zone
BS	: British Standards
ISO	: International Standardisation Organisation
ISPS	: International Ship and Port Facility and Security
PIANC	: Association for Waterborne Transport Infrastructure
UNCTAD	: United Nations Conference on Trade and Development
IMO	: International Maritime Organisation
IAPH	: International Association of Ports and Harbors
ICT	: Informations and Communications Technology
GDP	: Gross Domestic Product

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# 1 Introduction

To fulfill its promise in becoming the 4th world largest economy by 2050, President Joko Widodo ordered acceleration on 225 national strategic projects with Port of Kuala Tanjung (PoKT) being one of them (PWC, 2015; Presiden Republik Indonesia, 2016). As a national strategic project, PoKT draws significant attention from both the regional and international level. As a result, a joint venture (JV) between Indonesia state owned port enterprise "Pelindo 1," and Port of Rotterdam Authority (PoRA) was established. Currently, there are the JV, Indonesia ministries, Regional government, and local communities involved in the planning process of the port, with the private sector joining the discussion in the latter stage of the planning.

Due to the diverse set of stakeholders involved in the project, various conflict originated from each stakeholder interests is to be expected in the PoKT planning process. Besides the conflict of interests, there are also uncertainties and on-going disruptive developments coming from both internal and external part of the PoKT ecosystem, adding more complexity into the port design process. Therefore careful stakeholder management to accommodate those interest and an adaptable approach towards port masterplanning to handle various uncertainties and disruptive developments is critical towards the project success.

This research would use Adaptive port planning (APP) framework as primary reference (Taneja, 2013). An adaptable and robust port masterplan would be proposed using the existing PoKT masterplan as the starting point. Then, a first phase development would be chosen based on "no regret decision making" philosophy which allows it to be self-sustainable and provide catalyzing effect for the next phases of development. Finally, a business case would be formulated to enable the first stage development of the masterplan to be constructed. During the research, several in-depth interviews and discussions with experts from PoRA have been conducted. A case study would then be drafted based on the information that is received from the discussion to illustrate the significance of the research to the PoKT development

## 1.1 Problem analysis

To obtain a comprehensive bird-eye view of this complex on-going port construction project, a general description of each stakeholder interests and how they are relevant in the port planning process needs to be explained. These stakeholders were classified into three categories based on their interest towards the project. The first party is the Joint Venture entity between Pelindo 1 and PoRA which plays the central role in the project and categorized as goal driven stakeholders. The second party is the governmental institutions starting from national (Indonesia and Netherlands) level down to the regional level, the local communities such as NGOs and other external non-profit organizations are categorized as value driven stakeholders. The third party is the private and financial sectors such as investors, port operators, banks, shipping line company and other external commercial company are categorized as profit driven stakeholders. An extensive elaboration was given into the relationship between Pelindo 1 as the main project owner/stakeholder with PoRA as the Joint Venture partner.

Pelindo 1 and PoRA JV categorized as goal driven stakeholders because they are the initiator of this project. They have a clear vision and are determined to realize this project. However, due to the difference in the port governance model adopted in Indonesia (which in this case represented by Pelindo 1) and The Netherlands (which represented by PoRA), numerous debate in the project internal institutional level cannot be prevented especially regarding the division of tasks and revenue model of the JV. Before 2008, Indonesia adopted service port model, where the role of Terminal Operator and Port Authority was monopolized by four state-owned companies called Perusahaan Pelabuhan Indonesia (Pelindo).

According to state regulation no 21 year 1992 about shipping, these four pelindos were given the authority to regulate ports in all cities within their territory as illustrated in Figure 1.



*Figure 1 Pelindos designated territories, Source: Author*

In the new state regulation no 17 year 2008 about shipping, the government issued an amendment to the shipping law and made significant changes. In this shipping law, Pelindos which previously held total control of the ports within their region ranging from planning, construction, regulations, and down to operations. Now they only act as port operator, and the port authority role was given to new government institution under the Ministry of Transportation called “Otoritas pelabuhan,” indicating Indonesia's intention to change from service port governance model into landlord port governance model. It should be noted here that Pelindos role now is as port operator, not as a terminal operator. They have the power to operate the whole operations within the port, ranging from berthing navigation, cargo handling, and hinterland activities. Therefore, their role extends beyond a merely terminal operator. The new entity, “Otoritas pelabuhan” would have a role of port masterplanner and regulating body of all port related activity. For instance, if Pelindos want to expand their terminal, they would need to have approval from Otoritas pelabuhan.

However, due to the unclear separation of duties between Pelindo and Otoritas pelabuhan and absence of a clear time-bound transition plan in regulation no 17 year 2008, there are minimal to no changes occur with Indonesia port governance model since then. Typically, in a landlord port model, the port authority in the form of a publicly owned enterprise such as PoRA owns the land under the municipality jurisdiction. They have the authority to regulate the lands given to them by the government as long as it is according city rules and regulation. They obtain their major revenue stream from land lease fee and port dues. They do not handle daily port operations directly as it is the task of terminal operators who rent the land from PoRA. In Indonesia however, the majority of land ownership still belongs to the Pelindos, not to the Otoritas pelabuhan. There is even some part of the land inside a port area which belongs to private companies or individuals. Land acquisition and ownership in this regard are still can be improved in Indonesia. The Otoritas pelabuhan is only acting as government regulations agency without any commercial activity planned in their job description. Therefore, their role as port authority somewhat limited due to lack of resources and currently, Pelindos still considered acting dominantly as both Port Authority and Port Operator.

Continuing into the next stakeholder category which is the value driven stakeholders. They are defined as a set of stakeholders which place more importance on their specific value

parameter compared to financial parameters. These values could be in forms of jobs created, environmental parameters or other social parameters. The source of the problem would be their very diverse background and goals compared to the goal driven and profit driven stakeholders, as each representative of value driven stakeholder would have different interest with other Value driven stakeholder. For instance, a fishing community would demand a guarantee of sustainability of their fishing ground while the central government would emphasize on jobs created and economic growth of the region as the result of the project. Nonetheless, these demands could be generalized, as most value driven stakeholders direct their attention towards sustainability and growth. A brief scan towards each stakeholder interest and stand-point towards this project are as follows:

- The national government of Indonesia stated their commitment in supporting this project by listing it under the presidential decree no 3 year 2016 regarding the acceleration of strategic national project. Related ministries such as Ministry of State Owned Enterprise, Ministry of Transportation, Ministry of Environment and Forestry, Coordinating Ministry of Maritime, Ministry of Marine Affairs and Fisheries and Ministry of Public Works would, therefore, expected to provide support to the project under good intention as the President commands.
- The regional governments there would be North Sumatra for provincial level, Batu bara for regency level, and the municipality of Kuala Tanjung which is directly influenced by the presence of the Port. In general, these regional government supports the project without any relevant conflict of interest.
- The neighboring city of Sei Mangkei where large industrial area located such as palm oil and factories. This city would become an important business partner for the PoKT. Cargos from and to this city would be delivered through the PoKT which located nearer to Sei Mangkei city than the existing port of Belawan. Therefore, in general, they are very supportive towards this project. Their major concern is a risk of direct competition as result of cargo import done by Kuala Tanjung. The Certain agreement needs to take place to clarify specifically how PoKT and Sei Mangkei would collaborate to bring out the full potential of both sides.
- Inside the city of Kuala Tanjung, the public opinion would play important role in assuring the success of the project, especially during the land acquisition stage. Numerous dialog with local NGOs and associations such as the fisherman association have been held to ensure the majority of public concern have been taken into account in the port planning process. In general, they are very supportive of this project knowing that significant amount of jobs would be created. Their major concern would be the environmental safety as a result of port activities which need to be regulated sustainably.

Lastly, the profit driven stakeholder who are defined as future clients and tenants of the port that provide jobs, business activities, and source of income in the port area. They are the private companies, investors, and banks. Compared to the previous type of stakeholders, these stakeholders would provide the most objective and conservative judgment as they possess no emotional nor strategic attachment towards the project. Their judgment would be based on financial and economic feasibility analysis in the form of business cases. The level of details of this business cases would depend on the type of private companies, financiers (banks and investor), investment object, and the funding scheme. In the PoRA, the business case conducted using Discounted Cash Flow (DCF) method. This financial tool chosen as it is globally accepted by banks and potential business partner in the port industry. Profit driven stakeholders, in this case, would be attracted to invest or sign a business agreement with the PoKT JV if the resulting Net Present Value (NPV) based on DCF calculation is positive. This requirement poses a problem for the project because the large civil structure would often provide negative NPV in their first years due to the absence of revenue and huge expense on construction costs. Furthermore, it should be noted that based on A.M Best's (2016) assessment, Indonesia has a high level of political and financial system risk with moderate

economic risk. This assessment might influence investment decisions in Indonesia such as the interest rate of bank loan. The JV then would need to find for a solution to make the PoKT NPV positive which then would attract potential investors and business partners.

It is important to state here, that there is already a fully functioning port of Belawan located approximately 140 km from the PoKT. It is obvious that both of this port would share the same hinterland. However, thanks to Indonesia port governance model, port of Belawan is directly regulated by Pelindo 1. Therefore certain strategic decision can be executed to prevent direct competition between these two ports which would result in poor productivity for these two ports.

Having stated the complex demand of each type of stakeholders, a robust masterplan would be required to satisfy all stakeholders requirement and provide advantages towards PoKT over its competitors. Based on problem analysis as mentioned above, the Joint Venture need to incorporate certain basic specification into the masterplan to satisfy all basic stakeholder requirement as follows:

- Produce positive NPV for the most scenario in the future so that the investment can be justified by the profit driven stakeholders (private companies and banks)
- Provide enormous positive economic and societal impact as added value for the neighboring environment for the most scenario in the future so that non-commercial investment can be justified by the value driven stakeholders (governments and local community)
- Avoid direct competition with already established industry, including but not limited to sei mangkei city industrial zone and neighboring port of Belawan

Such a robust masterplan nevertheless requires flexibility and sustainability to be incorporated into the planning. The resulting port masterplan would have a concrete and sturdy design which requires phases in its development. The main problem for the Joint Venture soon would be to trigger the construction of the first phase of the masterplan development. A smart business case is needed to justify investment decisions and attract the investors into funding the first phase of the masterplan. The layout of the first phase development should be designed in such a way that it has the self-sustaining capability and catalyzing effect towards the next phases of the development. Self-sustaining means that the first phase is feasible in itself and can provide positive NPV most of the time without depending on the latter phase of the development. Catalyzing effect means that the first phase is not only compatible with the latter phase of development, but also ease the construction of the next phase.

## 1.2 Framing the problem

Next, set of boundaries for the research has been determined as follows:

- The starting date of interest would be November 2016, when the Joint Venture agreement signed. All activities prior to this date would be neglected and not being taken into account in the port design process.
- The main assumption for the PoKT governance model would be land lord governance model as agreed by the JV.
- The area of interest for the research is a robust port masterplan which capable of generating positive NPV under multiple scenarios in future and a business case which enables the first phase of the masterplan to be constructed. The business case itself should prove that the first phase of the masterplan has self-sustaining and catalyzing effect feature towards the next phase of the construction.

- A Clear distinction should be done in construction a business case for the profit was driven stakeholder and the value driven stakeholder. Profit driven stakeholders would be more concerned about the revenue stream and cash flow of the whole business, while value driven stakeholders would be more concerned about the added value in their environment after the existence of the port. The main emphasis would be given towards the construction of the business case for the value driven stakeholder. Thus, the resulting business case would be more suitable to be presented to government officials, NGO's, and local communities audience.
- In developing the port masterplan and first phase business case, various port engineering and financial tools would be used. Since it is a broad and multidisciplinary topic, the focus of the research would be on the technical port planning aspect, suiting the body of knowledge in the Hydraulic engineering department. Basic financial parameters would be used as the basis for business cases evaluation, but would not be the focus of the research.

### 1.3 Problem formulation

The main research question would then formulated as follows:

*“How can an **adaptive** Port of Kuala Tanjung masterplan be designed together with its corresponding first phase layout and business case which **triggers** the Port of Kuala Tanjung first stage of construction works, while ensuring its **self-sustaining** capability and **catalyzing effect** with the next stages of the development?”*

To help answer this main research question, the following sub-questions were formulated:

1. What are the major future challenges confronting ports?
2. What will an adaptive Port of Kuala Tanjung masterplan look like?
3. How can the first phase development be robust and self sustainable, so that it attracts investors and triggers the construction works in practice?

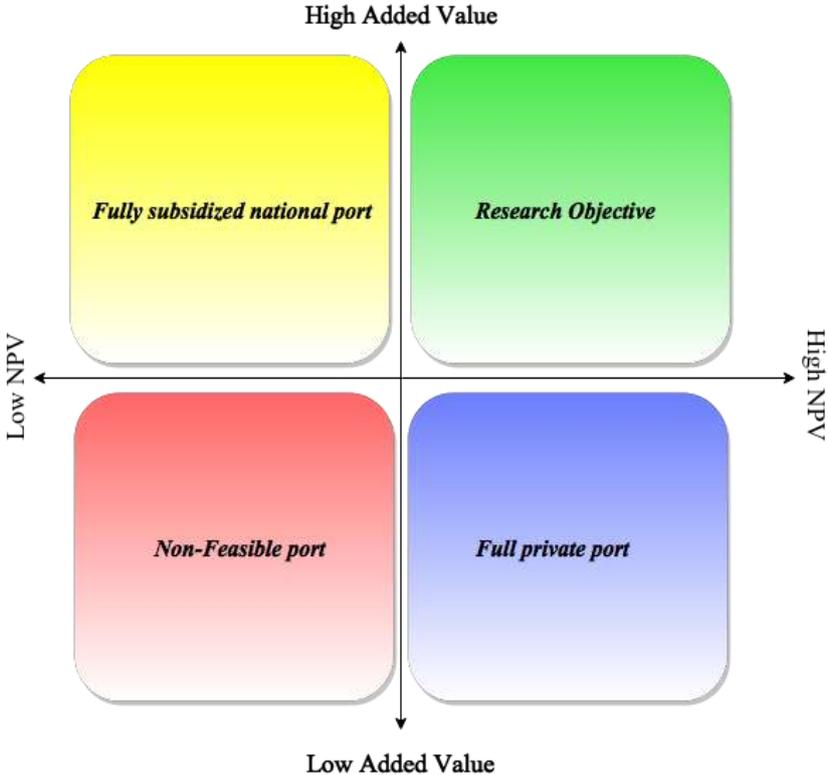
### 1.4 Guiding principles and Planning philosophy



Figure 2 United nations sustainable development goals, source : United Nations, 2016

A sustainable port developments should always introduce significant added value for the surrounding community while still being profitable financially and respecting nature and environment at the same time. To realize that, efforts in optimizing environmental and social benefit should be the main goal right from the beginning of the planning process and not just as an auxiliary item for corporate social responsibility. The United Nations Sustainable Development Goals (UN-SDG) is referred in this regard as the guiding principles of PoKT port planning process (Osborn & Ullah, 2015). It should be noted that due to its large construction and activity scale, all 17 aspects of the UN-SDG would be relevant to the PoKT development. However, the number 8 (decent work and economic growth), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), 14 and 15 (life below water and on land) of the UN-SDG have been used as the primary indicator in determining the added values that are created by the construction and operation of PoKT. On the other hand, number 7 (affordable and clean energy) and number 13 (climate action) are also relevant for the development of PoKT. However, since it would be difficult to measure the added values created in the number 7 and 13 categories, they would be excluded as an added values indicator in this study.

**Planning philosophy - Paripurna**



*Figure 3 Planning philosophy, Source: Author*

Since this port project holds a critical position in realizing Indonesia’s world maritime axis agenda, incorporating Indonesian values in its planning process right from the beginning, would be essential to ensure succesful communication with the Indonesian stakeholders . By doing so the relationship between PoRA and Indonesian partners (Pelindo 1, government agencies, and the general public) could be further improved. For this reason, a single Indonesian word, “Paripurna” has been choosen as the PoKT planning philosophy, which is familiar for Indonesian general public.

Paripurna means complete/comprehensive (BPPB, 2016). This word often being used in a formal government meeting in the form of “Paripurna Meeting/ Rapat Paripurna” indicating the highest forum in decision making which could be done by a certain organization or government agency. In the context of PoKT port planning, “Paripurna port planning philosophy” means a continuous, comprehensive port planning process. The term “continuous,” reflects a belief that a port planning process is a never ending design cycle. The challenges a Port faces during its operation would always evolves with time and space, therefore, demanding different approaches and solutions for different challenges whether it is technical, financial, social, or environmental challenges. “Comprehensive” term, on the other hand, means to take into account all relevant internal and external factors as an effort to realize a **sustainable port industrial complex** which is **profitable** and create **significant added value** for the surrounding region at the **same time**.

## 1.5 Research methodology

In order to answer the research questions described in section 1.3, this thesis would use a modified version of adaptive port planning framework (Taneja, 2013). The modification was done to enable the framework to produce two different layout, one for the masterplan and one for the 1<sup>st</sup> phase development. Therefore the framework would be done in two parts as illustrated in Figure 6. The 1st part of the APP framework would contain the first three chapters of this thesis. The **first** chapter would focus on conducting problem analysis and determine the objective for both first and second part of the framework. Next in the **second** chapter, the definition of success for both part of the framework would be formulated based on the identified scenarios and United Nations Sustainable Development Goals. Once the objective and definition of success for both part of the framework have been acquired, the existing masterplan and 1st phase layout of PoKT would be made adaptive in the **third** and **fourth** chapter respectively. At this point, the first and second sub-research questions would have been answered. Continuing to the framework, the evaluations for the 1st phase layout would then be conducted in the **fifth** chapter in terms of financials (business case) and added values. Finally the selection the most preferable alternatives would be conducted in the **sixth** chapter, by using the reflections as the main argument.

In order to increase the robustness of the object of interest in the each respective research part<sup>1</sup>, various type of actions needs to be considered as a response to the identified opportunities or vulnerabilities. In APP framework, these action classified into a shaping, mitigating, hedging and seizing action. The basic idea is to either execute the actions now, or prepare it in advance for later use. Explanation on the type of actions presented in .

*Table 1 Type of actions in APP Framework (Taneja, 2013)*

	Shaping	Seizing	Hedging	Mitigating
Timeframe	Now	Now	In the future	In the future
Objective	<b>Shape</b> external future developments towards <b>preferred</b> scenario	<b>Seize</b> opportunity for a <b>fairly certain</b> event	<b>Spread</b> risk for a <b>highly uncertain</b> even in current project cycle	<b>Reduce</b> the probability of vulnerabilities to happen in a <b>quite certain</b> event

<sup>1</sup> Research object of interest part 1 = PoKT masterplan; part 2 = PoKT 1<sup>st</sup> phase layout

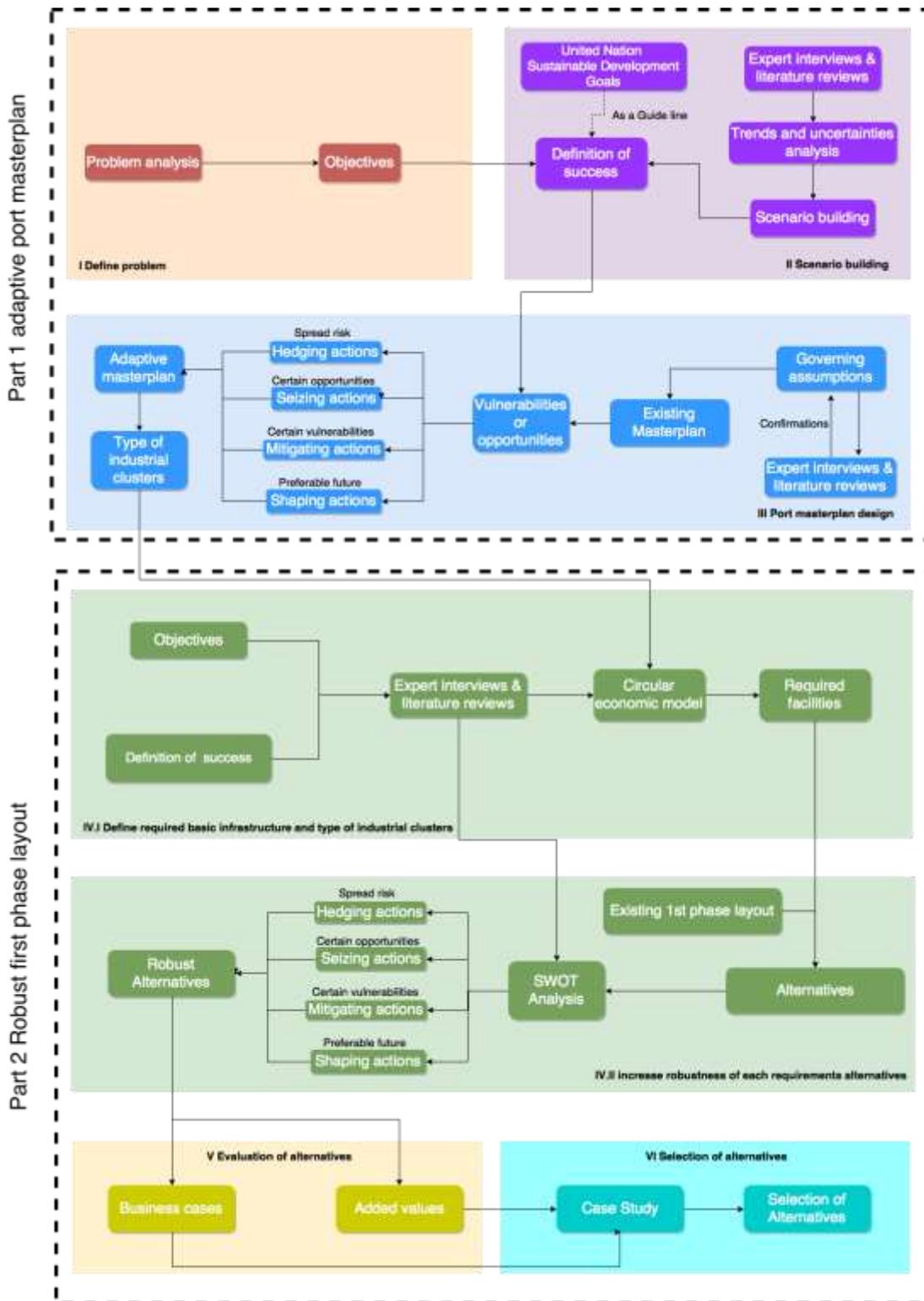


Figure 5 Port of Kuala Tanjung Adaptive Planning Framework (Poonam, 2013 with modification)

### 1.5.1 Research objective

Based on the research question in section 1.3, the objective of each part of this research was drafted as follows:

- **Part 1 Objective:** Make the existing port masterplan adaptive to be able to withstand most-plausible scenarios in the future.
- **Part 2 Objective:** Make the existing 1<sup>st</sup> phase port layout self-sustainable with catalyzing effect for the next phases of developments.

### 1.5.2 Research approach and strategies

In order to execute the thesis framework mentioned in Figure 6, several work has been done and were compiled in Table 2. A flexible approach towards the study has been adopted, while maintaining a clear objective on each phases of the study. The type of work or methodology that needs to be done varies greatly depending on the availability of the resources (data and experts available) at that time. In a time where the prepared methodology (i.e: focus group discussion or interviews) could not be conducted due to time constraints, an analysis using all available data would be provided. The accuracy of the analysis would then be described qualitatively and be consulted with the experts in PoRA.

*Table 2 List of work that has been done and its role in the thesis project*

Work that has been done	Product	Relevant section in the thesis
Developments relevant to ports research	Figure 6,7,8,9 and Table 4	Section 2.1 & 2.2
Plausible scenario based on discovered developments research	Scenario naratives, Figure 10 &11, Table 5	Section 2.3
Identifying existing masterplan vulnerabilities and opportunities	Table 7 and 8	Section 3.4.1
Make the existiting masterplan adaptive using the “action set” (action set = combination of hedging, shaping, mitigating, or seizing actions)	Table 9 and 10	Section 3.4.2
Research on how to <b>classify</b> the industrial cluster in an adaptable way	Alloy, Petrochemical, and bio-based clusters. Table 9, 10, 17	Section 3.4.2; Chapter 4 & 5
Draw a conceptual layout of the port masterplan based on the identified cluster classification	Figure 16	Section 3.43
Develop an industrial cluster <b>model</b> using circular economy concept	Figure 19 “Port of Kuala Tanjung Circular Economy model	Chapter 4 & 6
Identify minimum required <b>facilities</b> for the 1 <sup>st</sup> phase development using figure 19	Table 12 & 13	Section 4.1.4; 4.2 & 4.3

Work that has been done	Product	Relevant section in the thesis
Develop 3 alternative layouts <b>based</b> on <b>type</b> of industrial clusters (alloy, petrochemical, and bio-based) <b>and</b> the <b>existing</b> 1 <sup>st</sup> phase layout	Table 14, Figure 20	Section 4.1.4; 4.2 & 4.3; Chapter 5 & 6
Calculate the required terminal area using industry and Ligteringen & Velsink (2012) benchmark	Figure 20, Appendix C	Section 4.2; 4.3; Chapter 5 and 6
Conduct SWOT analysis on all 1 <sup>st</sup> phase layout alternatives	Table 14	Section 4.2; 4.3 & Chapter 6
Enhance the robustness of each 1 <sup>st</sup> phase layout alternatives by applying the action set on the SWOT analysis	Table 14	Section 4.2 & Chapter 6
Calculate the adjusted cargo throughput for each layout alternative based on existing cargo forecast and prospected 1 <sup>st</sup> industrial tenant	Appendix C	Chapter 5
Calculate the CAPEX for the required facilities using the previous business case and Indonesia Ministry of Transport Regulation (PM no 75 year 2013)	Appendix D	Chapter 5
Calculate the OPEX for the required facilities using the previous business case	Appendix D	Chapter 5
Calculate the Income by using the adjusted cargo throughput for each type of cluster and the service tariff from the previous business case	Appendix D	Chapter 5
Calculate the business case using discounted cash flow method. The weighted average cost of capital (WACC) that is being used here is as a result from the Port of Rotterdam financial team analysis and has been validated through literature review	Appendix D	Chapter 5 and 6

Work that has been done	Product	Relevant section in the thesis
Research on the added value being created by each cluster alternative based on UN-SDG classification	Added value narratives, Table 17	Chapter 5 and 6
Focus group discussions, interviews, and various type of questionnaire survey (both open and closed questions) with port of Rotterdam experts	Port of Kuala Tanjung reflections narratives	Chapter 6

### 1.5.3 Glossary of Terminology

In this sub-section, definitions on the key concepts that are being used in this research were provided as follows:

- **Layouts:** A drawing plan of a section or the whole port, describing the position and intended use of every available land slots and basic infrastructures.
- **Adaptive port masterplan:** A comprehensive set of documents which contains the long-term port vision and layout (for the next 30 year) and also the corporate strategy designed to realize it. The vision and strategy often comes in form of narratives while the layout in a form of drawing.
- **Robust first phase layout:** The layout of the first phase development of a port from an empty land, otherwise called a green field port. A “Robust” first phase layout means the port is designed to be able to operate within acceptable standards in most plausible future scenarios by having self-sustainability and catalysing effect property incorporated in it.
- **Self-sustainable:** Indicates the ability of the Port layout to gain more revenue than operating expenditure without any dependence on the next stage of development and adding values to the neighbouring region simulatenously.
- **Added values:** Benefits that are created by the port construction and operation which do not directly provide financial benefit for the port cooperation itself, but rather by increase the life standard in the neighboring region. In determining the added values a port could bring into the region, the United Nations- Sustainable Development Goals has been referred as the classification method.
- **Catalyzing effect:** The catalyzing effect applies to both commercial and infrastructure context.
  - In infrastructure context, it implies that the first-phase port infrastructure either creates the environment of the next phase’s infrastructure or avoids obstructing future construction developments, thereby enabling faster and cheaper construction work and enables clusters to develop at the next phase.
  - In a commercial context, a catalyzing effect means that the first phase of the Port would consistently generate a good financial portfolio to attract potential investors and future tenants in the industrial port complex.

- **Developments:** A dynamic changes of an observed events within a period of interest which have either direct or indirect influence towards a port's performance
- **Circular economic model:** A port logistic model designed to enhance its self-sustainability and catalyzing effect properties
- **Required facilities:** Combination of a minimum set of terminal, basic infrastructure, utilities, interventions and industrial tenant that are needed for the port to be operational in its first phase development
- **Terminal:** A port area which act as the interface between the sea-side and hinterland (the land behind the port)-side of the port area. Cargo exchange from the ships and the port happened in this area of the port.
- **Basic infrastructure:** Static, **shared use** civil infrastructures that are needed for the port to function such as breakwaters, quay walls, jetties, trestles, and access roads.
- **Supra-structure:** Structures that could either be static (i.e: warehouse and offices) or moving (i.e: cranes) which serve a **dedicated tenant** in the port area. Since this study used a land-lord port governance model, the supra-structure calculations would **not** be covered in this study.
- **Equipments:** Moving vehicles (i.e: Trucks) or specific cargo handling facilities (i.e: Rubber Tyred Gantry) which serve a **dedicated tenant** in the port area. Since this study used a land-lord port governance model, the equipment calculations would **not** be covered in this study.
- **Utilities:** Series of facilities and networks designed to sustain the whole port operation. In its most basic set, it comes in package of clean water supply and network, electricity grid, communication tower, and waste treatment facilities
- **Interventions:** Engineering activities which are conducted to modify the nature landscape into a preferred landscape by taking into account the sustainability aspects (i.e: Dredging, reclamation, and river diversion).
- **Industrial tenant:** Prospected industrial companies that will be persuaded to build its factory in the dedicated land slot within the port area and pay lease fees for it. These factory must require some portion of its feedstock from outside the hinterland and export some portion of its feedstock to promote stable cargo flow in the port.
- **Industrial cluster:** Collection of industrial tenants that are strategically placed near to each other to enable access for shared basic infrastructures and utilities. The type of the industrial tenant will be selected in such a way that it optimize the implementation of circular economic model within the cluster.
- **Industrial port complex:** The long-term picture of the port development where two or more industrial clusters will be operational in the port such as in the Port of Rotterdam (i.e: Petrochemical, alloy and bio-based clusters).
- **Alternatives:** Option of layout alternatives based on the type of its 1<sup>st</sup> industrial tenant
- **Business case:** An evaluation tool for a project financial feasibility. In this study, the business case will be calculated using discounted cash flow (DCF) method. From the DCF method the net present value (NPV) of the project could be estimated. A positive NPV means that the project is profitable in its self, while a negative NPV means that the project will need an external support to be profitable.

- **Reflections:** Qualitative assessments on the research product using all accessible information during this period of research. The products which will be assessed would be the developments affecting ports worldwide, The PoKT masterplan, and The PoKT 1<sup>st</sup> phase layout. The reflections will be conducted in two ways, first using the port of Rotterdam perspective and second using the researcher perspective
- **Port of Rotterdam Perspective:** A sub-section in the reflections chapter dedicated to assess the research product from the Port of Rotterdam experts perspective. In this subsection, the assessment of the research product will be conducted with the emphasize on the commercial success of the PoKT and the risk that this project would generate to the Port of Rotterdam
- **The Researcher Perspective:** A sub-section in the reflections chapter dedicated to assess the research product from the researcher perspective. In this subsection, the assessment of the research product will be conducted with the emphasize on the economic and societal added values of the PoKT, as well as its role in becoming the international hub port in the Indonesia Tol Laut network.

# 2 Future Developments

## 2.1 Uncertain and disruptive developments

### 2.1.1 Properties of uncertainty

Uncertainty defined by existence of an unknown information regarding the cause and effect of a particular or series of developments towards a system of interest performance, originated either form exogenous or endogenous sector of the system itself. The port environment in this case would be treated as a system, and engineering system to be exact. An engineering system defined as man-made system designed to fulfill specific objective and functional needs to fulfill pre-determined requirements (Blanchard & Fabrycky, 2011), while the port environment defined as combination of technological, political, social and economic factor directly affecting the port itself (Taneja, 2013). It should be noted that the intention is only to minimize and manage uncertainty. The topology on uncertainty itself is best described by Walker, et. al (2003) with categorizing it into their location, level, and nature which is summarized in Figure 7.

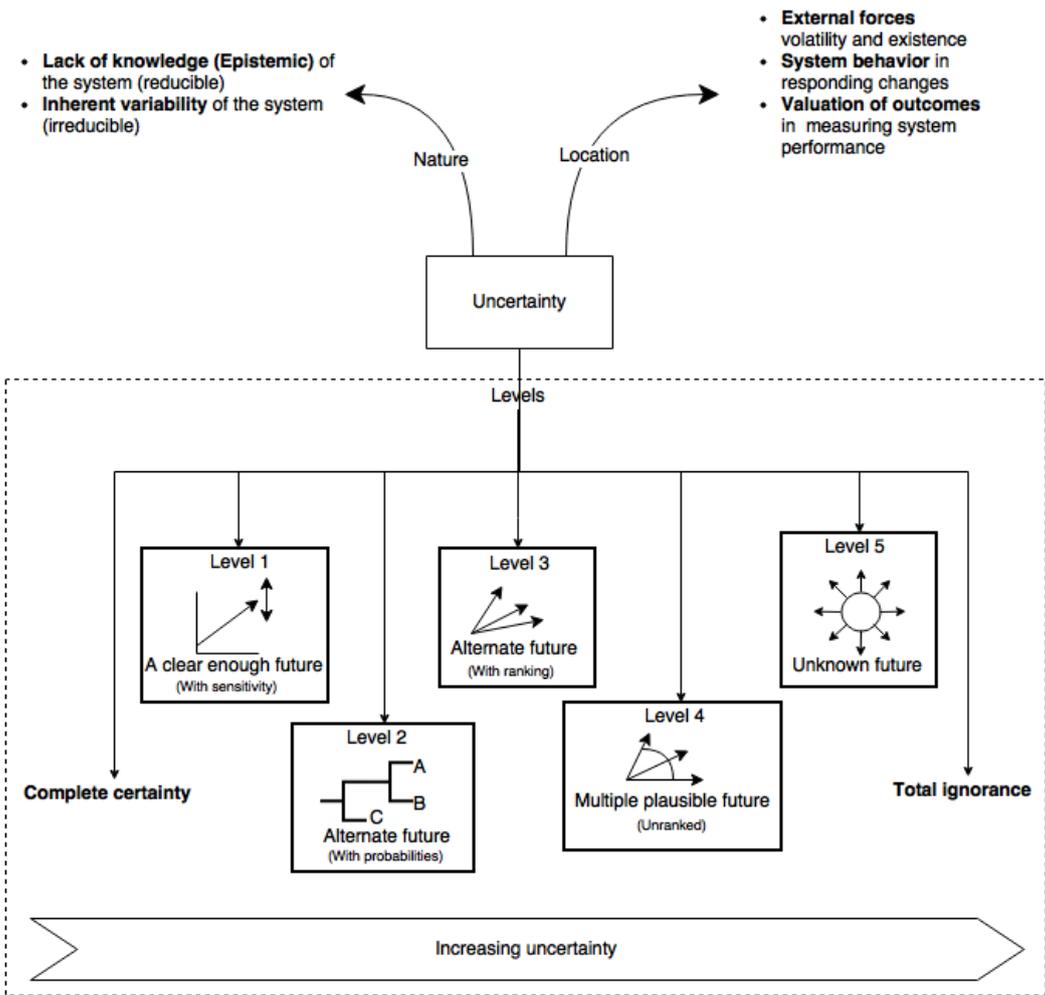


Figure 7 Topology of Uncertainty (adopted from Walker, et. al, 2003)

An important concept in the nature of uncertainty which needs to be further elaborated is epistemic uncertainty and inherent uncertainty. Epistemic uncertainty originates from the lack of knowledge of a system, which may be reduced through scientific research, optimization, or knowledge exchange. On the other hand, inherent uncertainty originates from the random nature of a variable itself. For example, in a steel mill, the probability that a produced steel will be up to standard may be increased through decreasing the factory's epistemic uncertainty. This means it may be achieved through better technology, production processes, or other forms of optimization. However, due to the inherent uncertainty contained in the production process, the probability that a produced steel will be up to standard will never be 100%. This inherent uncertainty may be located in the variability of the iron ore's quality as the main steel mill's feedstock or in the performance variability of the steel production equipment itself.

### 2.1.2 Properties of Disruptive developments

Danneels (2004) wrote, "Disruptive technology can be thought of as a technology that changes the essence of competition among firms by transforming the performance metrics". Based on Danneels (2004) explanation and Walker, et. al (2003) uncertainty topology, a more elaborate definition of disruptive developments would be proposed as follows.

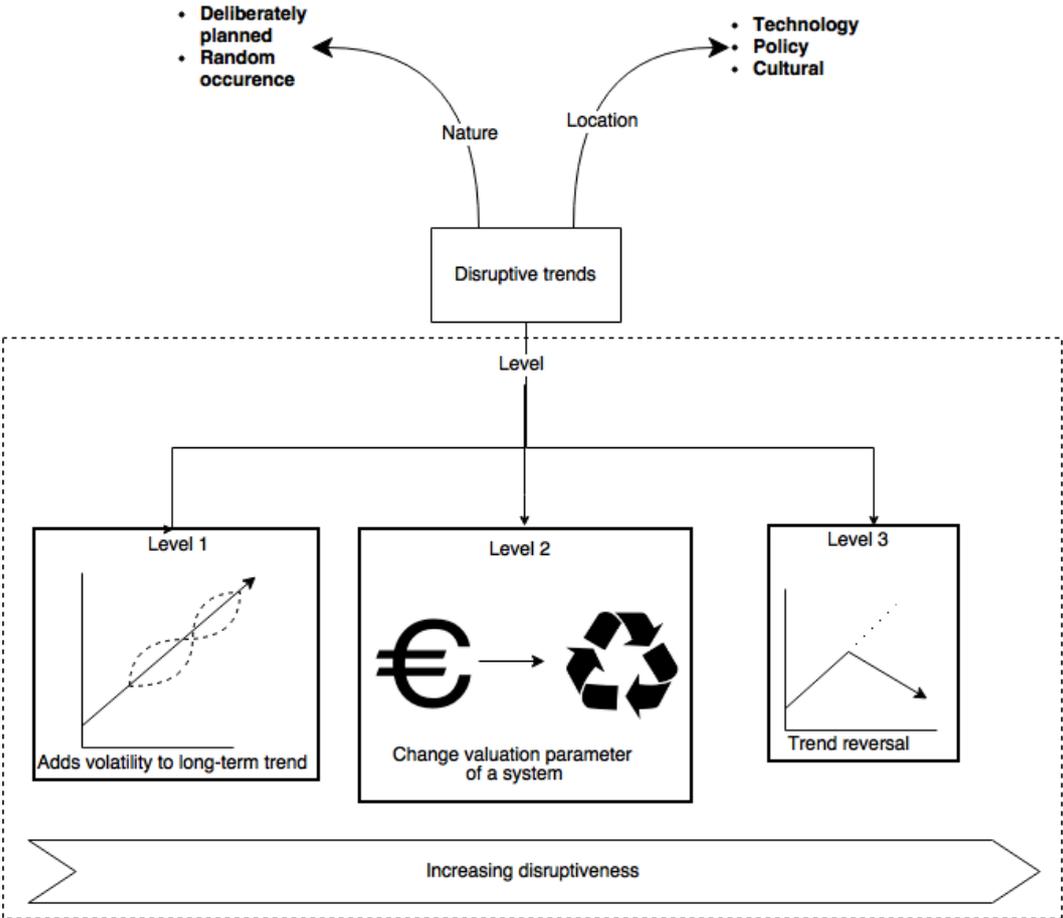


Figure 8 Topology of disruptive developments (Source: Author)

Disruptive developments are defined as developments which add volatility into a relatively stable, long-term developments, while changing entirely how the performance of a specific topic in the system of interest is measured and eventually causing long-term developments reversal after a certain period of time. The emphasis on the definition is that disruptive developments should be time-bounded. Each disruptive developments should be identified and assessed sequentially by taking into account the contribution of the previous developments and knowing that each of the developments are unique for their specific era and field of interest. However, the argument on the period, or the start and finish, of each developments depends heavily on the observer's point of view and the field of interest. Therefore, in categorizing disruptive developments it is not advisable to use time as a reference frame. The study of the effect of previous, ongoing, and potential disruptive developments on a system's performance have been conducted on various fields, primarily with intention to maintain the competitive edge of a company ahead of its competitors. This edge involves having the knowledge to assign appropriate resources in a way that increases the chance of benefitting or mitigating the potential vulnerabilities from the existence of disruptive developments (Dotsika & Watkins, 2017).

**2.1.3 Good manner in handling Uncertainties and Disruptive developments**

Uncertainties and disruptive developments jointly can be perceived as a blessing or curse in disguise depending on a system point of view. The nature of their interaction can be visualized as in figure 6 with some degree of independency between each other but still somehow related. Each phenomenon started as “uncertainty dominated” and growing towards “disruptive developments dominated” overtime. The uncertainty mentioned in this section only applies to epistemic uncertainty which arises from technical and scientific uncertainty, which therefore reducible.

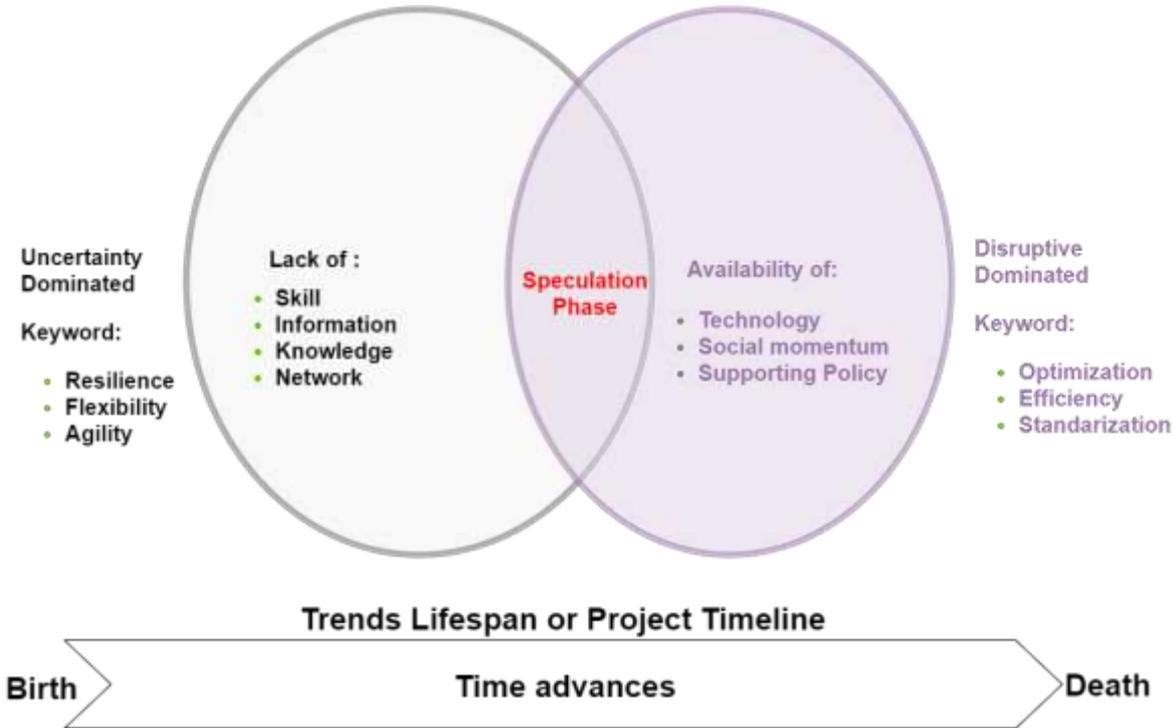


Figure 9 Uncertainty and Disruptive developments relation

When a phenomenon starts to occur, there is still a very little amount of data acquired regarding its effect towards the imposed system. Therefore, there is a huge amount of uncertainty towards this phenomenon's performance and its profile as a disruptive development also has not been proved. As time progresses, during development, the way both properties interact is assumed to be independent with a tendency of lowering epistemic uncertainty and growing towards more disruptive with advance in time. This assumption is based on additional data and knowledge gathered over time; uncertain elements of the system can be reduced and the true extent of disruptive developments' effect can be discovered. The uncertainty and disruptive developments relationship in

Figure 9 are also applicable for port projects. In a **Green field stage**, ports are dominated by uncertainty in their development. There are simply too many elements in the port construction, management, and commercial services that are still not known for sure, even with the state-of-the-art forecasting method. The challenge for this stage of development is that ports need to invest a significant amount upfront for large infrastructure without having guaranteed revenue streams in the process. This condition places green field ports in huge financial risk. Therefore, the focus of these ports should be **resiliency, flexibility, and agility**. While for matured **brown field ports**, due to prolonged exposure towards port operation, experienced workers and well-established port organizations, epistemic uncertainties should be near diminished. These ports would be dominated by on-going disruptive developments. The scale of the disruptive developments would differ depending on the scale of the ports. For instance, gateway ports would be affected by global disruptive developments while small feeder ports would only be affected by regional disruptive developments. In order to prevent stagnation and maintain a competitive edge compared to other port competitors sharing the same hinterland, brown field ports should focus on **optimization, efficiency, and standardization**. Having illustrated the complexity surrounding uncertainty and disruptive developments in the port industry, proper identification and relevant strategies are required to manage it optimally. Nonetheless, only those who are cautious, agile, knowledgeable, and visionary enough can gain real benefit and grow from it. Uncertainties and disruptive developments are part of an eternal cycle of the world system that will stay forever. Ports are given choices to either gain advantage and prosper from it or suffer defeat and have loss from it.

## 2.2 Nine principle uncertainties affecting world class ports

World class ports are defined as seaports that serve intercontinental shipping lines on a regular basis, fully compliant with international standards, and acknowledged by international organizations. These international standards were published by numerous organizations, each of which would have a different impact and significance towards a port, depending on its location. Some of the most practiced worldwide are including but not limited to EUROCODE, British Standards (BS), International Standardisation Organisation (ISO), and The International Ship and Port Facility and Security (ISPS). As for the international organizations that are relevant to world class ports are including but not limited to The World Association for Waterborne Transport Infrastructure (PIANC), United Nations Conference on Trade and Development (UNCTAD), International Maritime Organisation (IMO), and International Association of Ports and Harbors (IAPH).

Even though there are no universally perceived criteria of a world class port, these three characteristics would always exist on the majority of world class ports. This is due to the fact that these three characteristics simultaneously served as a filter for the world class. World class ports that are acknowledged by international organizations would simply have expensive operational costs in order to keep up with the international standards, relative to their regional counterparts. They would therefore need a stable large amount of income to keep up with their expensive operational costs. Regular arrival of intercontinental ships in this regard could provide a stable large income for the world class ports. Because the intercontinental ships always bring significantly larger amounts of cargo throughput compared to short-sea or regional ships.

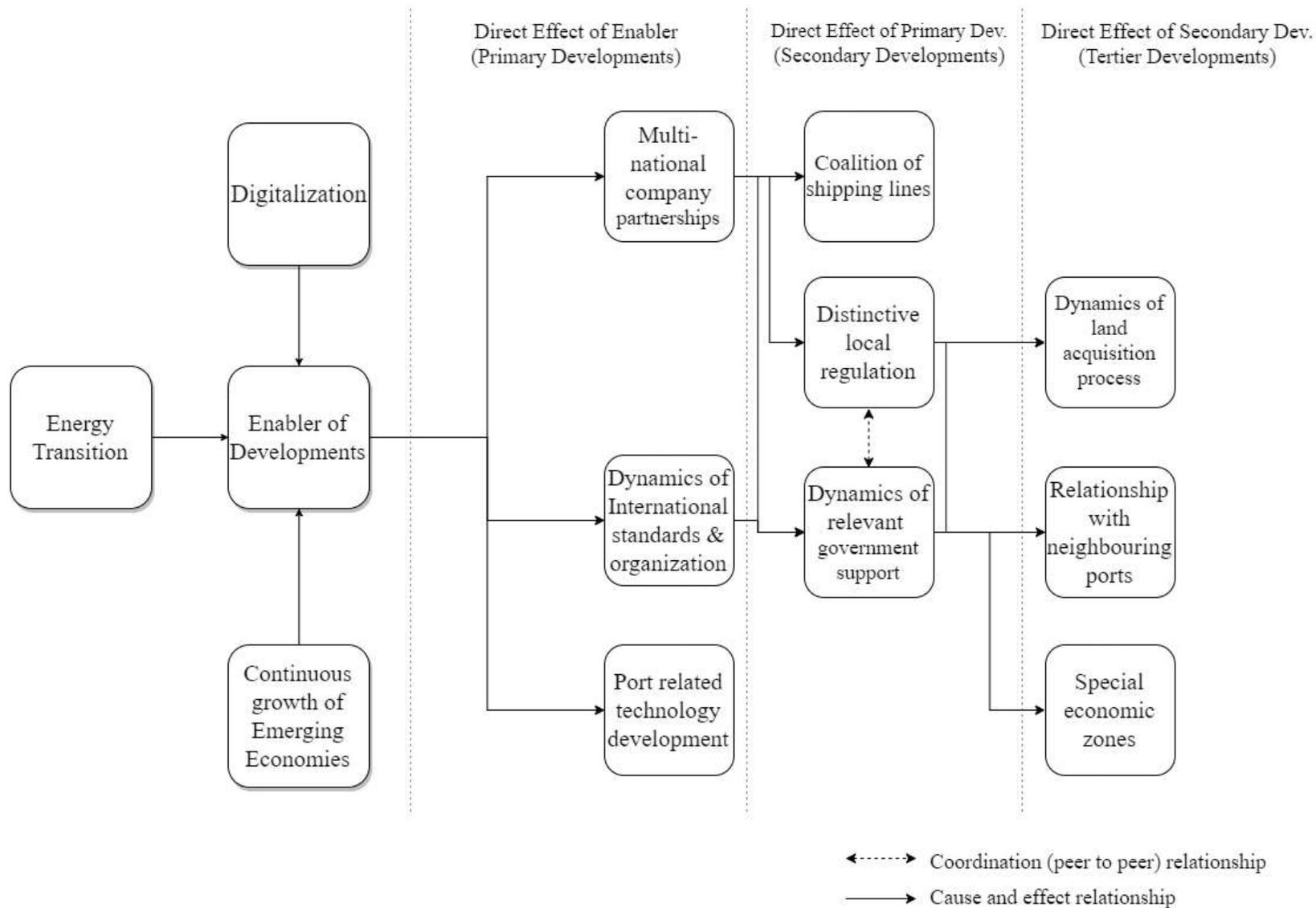


Figure 10 Developments relevant to port industry (Source: Author)

In order to identify the relevant developments on world class ports, combination of literature review and expert interviews have been conducted. Nine most relevant developments towards world class ports has been selected in no particular order. These developments are a result of the developments enablers: digitalization, energy transition, and continuous growth of emerging economies. These enablers are the essence of the “Nine drivers of change”, which are the nine categories of developments which stimulates changes in the world (PoRA, 2012). As this sub-section will only focus on the developments affecting the ports, explanations on the “Enablers” will only be given briefly.

First, the digitalization happening worldwide still continues in a rapid pace. Powered by the invention of computer and internet, the digitalization slowly but surely revolutionize all aspect of human activities, including ports. Smart ports has spawned in several places across the world by taking the advantage of the digitalized technologies (Berns, Dickson, Rob, Indra, Dragt, 2017). These smart ports are more efficient and robust in its operation compared with the analog ports. Not stopping in creation of the “Smart ports”, the digitalization would continue to enable other developments in the port industry to emerge. Therefore, the port industry will surely become increasingly more dynamic in the near future.

Second, the global energy transition from fossil based fuel towards renewable energies will affect the way port industries operate. The changes might come in terms of vessels fuel loading and un-loading mechanism as well as the ratio and type of cargos being transported (IEA & IRENA, 2017). This changes would potentially inhibit a port’s growth if not anticipated carefully in the port area planning. Moreover, due to its scale, the global energy transition would also stimulate other developments in a broad field.

Third, the continuous growth of emerging economies will shift the global cargo flow. Powered by mainly its population growth, China, India, Indonesia, and other emerging economy countries are steadily continued to grow its gross domestic product (GDP) for the last decade (PWC, 2017). This situation stimulates major changes in the world economy power, cargo flow, and businesses for the next four decades. The changes would definately also impact the port industries, enabling more developments to emerge in the near future.

The combined effect of the “Enablers” mentioned above has resulted in a more uncertain future for the ports worldwide. To anticipate the future of port industries and make the PoKT development adaptable, nine developments affecting ports worldwide has been identified as previously mentioned. Explanations regarding each developments effect on the PoKT development has been analysed an written in the “list of developments”. This “list of developments” should only be used as a “strategic situation check list” when determining a Port current position in the global competition as a part of port planning process. Attention should be given mainly towards the developments and not drivers as it is not the focus. The “list of developments” are presented as bullet points as follows:

#### • Multi-national company joint ventures

There have been an significant increase in number of multinational joint ventures in the last decades (Khana & Palepu, 2006). Various factor including but not limited to: globalization, population growth, internet, and rise of new global economic power in Asia; encourages both national and multinational companies to seek new opportunities. One solution to seize these new opportunities is establishing partnership with the local companies through joint ventures. The biggest advantage of a multi-national company joint ventures is that it offers the platform for the local entities (companies, government instution, academic institution, and NGOs) to collaborate and adapt their policies to suite their local needs (OECD, 2006).

In order to fully grasp the benefits of globalization and generate new opportunities for others, PoRA initiated the Global port network which would then be rebranded into world port network (Clasquin, 2014; PoRA, 2016). This network consists of PoRA’s port authority partners that are strategically located across the world. Considering the nature of the World port network joint ventures, it is considered to be the first multi-national port company

partnership network in the world. Currently there are two operating port in the network namely Sohar port in Oman and Porto Central in Brazil. PoKT is expected to join the network in the future.

Focussing on the relationship between PoRA and its partners in the world port network, just like other multi-national company joint ventures there would be several differences between the parent companies to be mediated in order to achieve success in the partnership. Since ports would compete with other port that are sharing the same hinterland, by definition, most<sup>3</sup> of PoRA JV partners in the world port network would be located in different continent other than Europe. The vast difference in location would result in distinct disparity in cultural background, government structure, and regulation framework between port Rotterdam and its Joint venture partners in World port network.

### **Implication towards port of Kuala Tanjung:**

Currently this variable falls in **Speculation phase**, due to relatively balanced amount of uncertainty and disruptive effect. The source of uncertainty relies in how far do both Pelindo 1 and PoRA willing to tolerate each other differences in terms of corporate and nationality culture, especially in terms of dividing authority. As for the disruptive effect, sourced heavily in different cultural background and corporate culture. In terms of cultural background, the Indonesians categorized in Reactive-multiactive cultural types which the Dutch in Linear active-multiactive type according to Lewis model (2006). It should be noted that this model is the result of Lewis own observation in a society during his work in multiple companies. It should only be served as general guidance and not be treated as absolute certainty. For simplicity, the main difference between Indonesians and Dutchs in this model is in the way they communicate and approach problems. Dutchs are more straight forward in their communication, while Indonesian have certain norms to follow. Indonesians tends to put emphasize in diplomacy and soft solution for their problem while Dutchs emphasize on hard facts and figures to determine their solutions.

In terms of corporate culture, the major difference between PoRA and their Indonesian partner, Pelindo 1 lies in the port governance model. Pelindo 1 adopted service port model while PoRA adopted land-lord model. In service port model, Pelindo 1 act as terminal operator and port manager, while in landlord port model PoRA act as port manager and port authority. Additional explanation regarding the difference in port governance model would be provided in chapter 3.

Knowing the complex situation at hand, advance stakeholder management will be required to not only mediate Pelindo 1 and PoRA differences, but also to bring the best out of both parties. Since both party have different cultural background and port governance model, a preliminary solution would be to establish a remote project organization in PoKT. This remote project organization should focus their attention on day to day operation and port masterplanning. The employee of the project organization will be consisted of combination of few senior staff of pelindo 1, few senior staff of PoRA, and significant amount of new employees from outside both company to preserve neutrality. On the other hand, strategic decision making (political lobbying, macro economics, and international relations matter) should be done outside the remote project organization by representative board member of Pelindo 1 and PoRA. By separating strategic decision making and operational decision making, faster and more sharp solution can be generated while producing less conflict of interest in the process (OECD, 2012). Clear distinction in categorizing which area falls in strategic or operational decision making and how the remote project organization communicate with the strategic committee board member is the key of success in this type of organization.

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<sup>3</sup> There could be some exception in the future, such as Port of Dordrecht

## Cultural Types: The Lewis Model

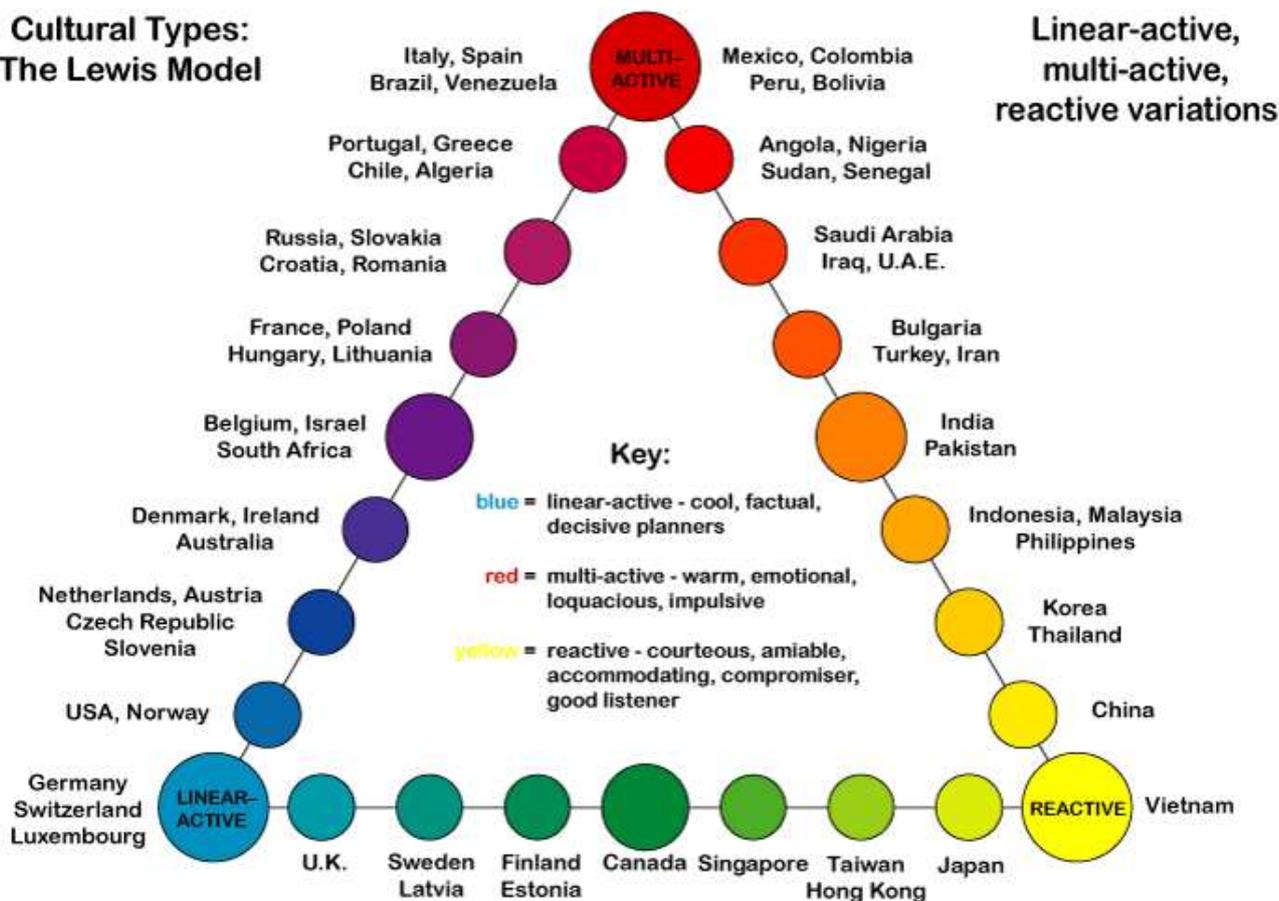


Figure 11 Lewis model of cultural types (Source: Lewis, 2006)

## International standards and organization

The competitive edge/position of a large ports in the world directly relates to its pro-active approach in applying the international standards. Driven by internet and globalization, international organization such as IMO and IAPH becomes more active than ever, thereby either dynamically producing or regularly amending existing port related regulations. Moreover, the area on which the regulations covers becomes broader yet specific. For instance in 1914, when the "International convention for safety of life at sea" (SOLAS) first adopted, there is no standards specifically directed to ports. Nowadays through the amendement of 1974/1988 SOLAS code, the "International Ship and Port Facility Security" (ISPS) code provide a more clear and strict regulation for ports to participate in a global trade network (IMO, 2017).

Taking into account the dynamics of these international regulation and organization, the standard approach of simply "following the rules" without pre-emptive action will always place a Port behind the competition due to its delayed response. Ports need to think ahead and predict what are the impact of recently published international standards to their performance and take preemptive actions. These actions should not only come in a form of compliance with the existing regulations but also in the Port an ability to seize opportunities or mitigate risks in the future. Maintaining good relationship with relevant stakeholder to win their preference (international organization, shipping lines, port related industry, and public opinion) would be the key in staying ahead in port competition.

## Implication towards port of Kuala Tanjung:

Currently this variable falls in **Disruptive dominated phase**, with the existence of new Indonesian regulations that clearly shows Indonesia intention in applying international standards in their facilities. For example, in UU 17 year 2008 about shipping Indonesia creates "Port Authority" which shows their intention in adopting landlord port governance model by separating port authority and terminal operator. The actual practice of the regulation nonetheless could still be significantly improved. Another show of good would comes in form of PM 134 year 2016 about ship and port safety management is an Indonesian adaptation in applying ISPS code, with little modification to suite Indonesia circumstances. It is clear that in term of regulations, Indonesia has tried to continuously follow up with international standards.

In case of PoKT, complying with both international and national standard is not a big issue. The presence of PoRA as a partner would ensure the Port have up to date compliant with existing port international standards, while Pelindo 1 would take in charge in conform the local regulation needs with the international standards. The real challenge would not only be meeting the standards in the first years of service, but how to maintain it and to anticipate any future standards. Adaptive port planning, in this case could provide helpful framework to maintain the Port performance in the long term.

### •Port related technology development

Facilitated by main driver of developments, port related technology continues to be developed rapidly. For simplicity, broad range of port related technologies has been categorized into three categories based on their physical attribute. There are hard structure, soft solution, and information and communication technologies. Hard structure technologies served primarily to provide horizontal plane in port activities (i.e: Jetty and pavements) in the area or for coastal protection (i.e: Groyne and breakwaters). The advancement of technology in this field often focused on lowering construction cost without compromising safety. Soft solutions technology involves building with nature by taking into account coastal processes in design calculation and primarily deal with coastal sediment transport in form of shoreline stabilization, dredging, or reclamation. The focus of technological advancement in this field would be to optimize sustainability aspects in its operation. Finally, in the field of informations and communications technology (ICT), most attention given in optimizing existing operations (i.e: internet of things) and processing digital data whether it is historical or forecasted data (i.e: Big data). Technological advancement in this field typically resulting in more efficient and safe port operations.

With numerous technology available at the disposal, the key in port planning success would be applying the right technology to handle a well defined problem in the right phase of the project. There are no general guide in how to properly adapt port related technologies, since each port would have specific problems depending on its location, financials, political situation, and many more. However as a rule of thumb, it could be argue that green field ports should put emphasize on hard structure technologies to reduce its capex and lower the burden on its early financial portofolio. Soft solutions should always be a priority in every alternative (if it is applicable) to promote sustainability and stay consistent with United nations sustainable development goals. While brown field port should invest more in state-of-the-art ICT solutions to further optimize their port system and stay ahead of competition. Extensive engineering calculations should always be done in every case to correctly decide which technologies should be applied to the port (at that moment) that will bring the best possible outcome without blocking opportunities or provide risk in the future, or often called "No-regret" decision making.

### **Implication towards port of Kuala Tanjung:**

This variable clearly falls in **Disruptive dominated** categories. There have been numerous new invention in port related technologies for the past decades such as: Automated Guided Vehicle (AGV), Foldable containers, Floating breakwaters, Magnet mooring system, Big data, internet of things, and many more. In the case of port of Kuala Tanjung, the focus should be on deciding which technology could be applied as soon as possible to enable the first phase development to be constructed. To serve that purpose, such technology should be cost-effective, easy to apply, and flexible. Cost-effective is needed so that such technology might help the first phase development of the Port to have positive business case, which therefore making it more easier to require funds from banks, creditor, investor, or other financier. Easy to apply required to accelerate the construction of the Port, so that it can operate as soon as possible and fasten the income phase. Finally flexible component in the technology is very important to make it compatible with the next phases of development, since the masterplan and the layout of the next phases would keep changing according to market situation and global condition.

In green field port such as Kuala Tanjung, hard structure technologies should be the first priority as it posses dominant cost ratio in the capital expenditure (CAPEX). Design of breakwater, jetty, terminals, and other large infrastructure should be drafted as small as possible but with possibility of expansion. In that way, the burden on the first phase financials can be minimized. Soft solutions and ICTs should be considered in the planning stage and applied when it is necessary. For instance, solutions for sediment carried by Bah Bolon river near Kuala Tanjung should be planned as early as possible without comprosing the local biodiversity and sediment balance. Alternatives such as river diversion and river cut-off should be studied in detail to balance out the impact it could bring towards the neighbouring ecosystem and economical benefit towards the Port.

### **• Consolidation of shipping lines**

Fair competition has always been the nature of shipping line industries. Large number of shipping lines constantly compete with each other by providing as low cost as possible with maintaining their safety level at the same time to ensure their cargo arrive at destinations in order to attract customers. As a result of this competition, larger ships developments start to occur in maritime industries to further lower the logistics cost. Larger ships means more cargo to transport in one trip which leads to better efficiency. However as the developments progress, the world shipping line industry eventually had reached severe overcapacity, which means there are more ships available than the cargo which have to be transported.

To solve the overcapacity problem, shipping companies had make alliances in the past to optimize the utililization their ships. These alliances are happening for all sort of cargo such as dry, liquid, cars, and breakbulk cargo, with container ships as the leader in the consolidation developments (Brrar, 2017 and Mooney, 2017). However, nowadays these alliance are larger than ever before due to the severe overcapacity of large ships in their fleet (KPPIP, 2017). This action prove to be a good judgement as it benefits all shipping line company within the alliances. Currently there are four major alliances recognised in the world as presented in Table 3. The consolidation of shipping alliances developments is expected to continue in dynamic fashion as the power balance between each shipping lines companies always fluctuates. This developments would then leads towards fewer calls with same or even more throughput for all port in the world in a year due to change of mean ship cargo size capacity.

*Table 3 Current shipping alliances in operation as September 2016, Source: KPPIP*

Alliance	Members	Established	Market share in the world	Fleet size
CKYHE	COSCO, K-line, Yangmig, Hanjin, Evergreen	2002	25 %	3.3 M TEUs
G6 Alliance	APL, Hapag-Lyod, HMM, MOL, NYK Lines, OOCL	2012	28 %	3.5 M TEUs
2M Alliance	Maersk, MSC	2015	27 %	5.7 M TEUs
Ocean Three Alliance	CMA-CGM, China Shipping, United arab shipping co	2015	15 %	3.0 M TEUs

### **Implication towards port of Kuala Tanjung:**

This phenomenon would be categorized as **Disruptive dominated**, as this developments expected to continue for a long time. Major shipping alliances would continue to change over the year in terms of member or fleet size until equilibrium condition being reach in which all shipping line company feel satisfied with their current position. This equilibrium condition would not be achieved in a short term, because currently the shipping line business is too volatile (Mooney, 2017). Therefore larger but less often call-to-berth vessel could be expected for at least the next 15 years.

To simulate the extreme effect of this developments, an arbitrary case example has been drafted. In the normal condition, a fully loaded container ship would not discharge all of its cargo in one port. It would travel to several ports, discharging and collecting container boxes along its way. In this arbitrary example, the virtual fully loaded container ship is assumed to discharged all its cargo into one port.

Assuming cargo throughput will not be affected in one port of the same region as it is directly related with the region economic condition not with the ship size, this will result in huge peak of cargo handling volume at one moment in time. For example, a fictionary port with one berth having throughput of 100,000 TEU/year would be used as an assumption. Previously this port would have 20 post panama vessel call per year with 5,000 TEU capacity in each call to satisfy its throughput. This 20 calls will be spread evenly throughout the year, meaning one vessel call every roughly three weeks. Now if the shipping alliances decide to fully utilize Maersk Triple E vessel with capacity of 18,000, that means only roughly 6 vessel calls needed to satisfy the same troughput. Which means there will be only 1 vessel call every 2 month. However, at that point of time when the cargo arrive from Maersk Tripple E vessel, an extra load of 13,000 TEU will be added to the port system. That is more than 2.6 times of loaded given to the system which needs to be handled seamlessly by the cranes, yard handling facility, stacking yard capacity, and hinterland infrastructure such as roads and rails. If there is small mistake whether in operation coordination in cargo handling or infrastructure damage along the system, there will be major congestion which cause huge loss for the port.

Relying only towards cargo handling service for the major shipping alliances would put PoKT in a high risk position. These large vessels, even though they might offer promising scheduled interval, they are considered as “foot loose” cargo. They would only call-to-berth to the cheapest port in the region. Competing head to head with already established port of Klang, Tanjung Pelepas, and Singapore is not a wise move, as newly born PoKT would surely be more fragile in terms of financial stability and JV managerial performance. Certain port development strategy need to be drafted by taking this “large ship” into account but not having them as the priority for cargo traffic business model.

## • Distinctive local regulation

Since there are increasing number of multi-national company joint ventures, significant number of new countries (other countries than the partnership originated) will be added as a stakeholder when the partnerships decided to expand their network. Distinction between the local regulation where the project take place with the regulations that the partnerships already familiar with, cannot be avoided. This distinction would not only comes in terms of numbers or figures, but also in the way the local regulation classify things and regulates them. The local regulations often relied heavily on a country's government system and other factors such as political condition, and cultural background which varies greatly in a global setting.

On the context of PoRA's world port network, partnerships could only be formed with other ports located in different hinterland to avoid direct competition. Sufficient vast distance between the Ports also required to make the partnership's traffic route economically beneficial. Therefore world port network partnerships usually formed with other port located in different continent such as the partnership between PoRA and Port of Sohar. With that being said, the developments of distinctive local regulation is even more relevant towards the Ports incorporated in the world port network. Different continent would mean significant difference in cultural background, countries ideology and government systems. An agile approach with clear vision would be required to compensate the differences and form the partnerships successfully.

### **Implication towards port of Kuala Tanjung:**

The effect of Indonesia regulations towards PoKT, not necessarily the regulation itself has **tendency** towards uncertainty dominated rather than disruptive dominated. The positive desired effect of these regulations would be to provide a stimulus for investors and potential foreign business entity to sign cooperation agreement or conduct business activities with Indonesia based companies whether they are private or state owned. However in practice, it would be hard to influence the market sentiment purely based on published regulations. Companies, banks, or investors would demand more certainty and simplicity not just in terms of high level regulations but also in its operational procedure and implementation. A relevant example in this case would be in terms of financing of large scale infrastructure project. Assuming if this project does use Public-Private-Partnership (PPP) scheme, its actual implementation of 'who pays what' and 'authority division' within the shareholder of the PoKT would be the main challenge that Indonesia government and the JV needs to solve.

Concrete government act in financial sector or bureaucracy reform would also help in forming productive market sentiment towards Indonesia which might benefit this project in a long term. This acts might come in forms of direct funding in the port basic infrastructure or international hub port status assignment. In short, it could be argued that supporting regulations are necessary condition for large scale project such as PoKT to succeed, but not sufficient.

Strategic decision making purely based on published government regulations is very risky as the desired market reaction simply too uncertain. It is more reliable to take collaborative action with the government and the private sector in a form of visible infrastructure or facilities that would attract future business partner. For instance, in the Indonesia National Maritime Coordination Meeting on May 2017, the government has re-announced several regulations to stimulate market activity. One of them is "Permen ESDM no. 35 year 2016" about private integrated petrochemical and refinery complex. In this regulation, the government has provided both fiscal and non fiscal incentive to attract potential industry to Indonesia.

In the case of Kuala Tanjung, it might be helpful to first coordinate either Indonesia state own enterprise (BUMN) refineries (i.e: Pertamina) of petrochemical industries (i.e: Pupuk Indonesia Holding company) to be located in the Port instead of just relying with regulations. By doing so, potential business partner would be more convinced to invest in PoKT seeing that the government have taken pro-active measure in enabling prosperous port industrial complex.

### • Challenging land acquisition

Land acquisition has always been the crucial step of every major infrastructure projects. If not treated carefully, it could cause significant delay which resulting in financial loss and loss of opportunity. Project examples in North Sumatera are including but not limited to the Kuala Tanjung Rail line, Multi purpose terminal, and three Toll road (KTPO, 2017). In extreme cases it could even canceled an infrastructure project such as happened to Arun III Hydroelectric Project in Nepal (Ghimire, Tuladhar, & Sharma, 2017). On the other hand successful land acquisition offers multiple beneficial effect. It could promote transfer of knowledge in multiple area and improve the relationship between the infrastructure's owner with local resident.

As an important economic asset, land not only provide space for economic activity to be conducted but also is closely linked to a community's heritage (UNEP, 2012). The way a community value a land ranging from a purely economic approach to a personal and emotional one, depending on a community's background. These diverse approaches in valuing the land may results in multiple disagreements in determining the land price which often leads to conflict in land acquisition, resulting in significant delay in the construction of major infrastructure projects. The land ownership certification method is also different for every country and region, making land acquisition process highly challenging for multinational companies that are used to different methods. Adding to the already difficult process, the existence of internet changes the way locals communicate with outside world, and thereby could make land acquisition even more challenging.

### Implication towards port of Kuala Tanjung:

In PoKT, the land acquisition process is conducted by the subsidiary company of Pelindo 1 called PT Prima Pengembangan Kawasan (PPK). PT PPK is directly in charge in purchasing the land from the locals and managing any conflict that may arise in the process. The current source of uncertainty would be the actual land acquisition progress and the method done in practice by PT PPK. It should be noted that it is crucial for the JV to have the same understanding on build-able land plot to enable efficient port masterplanning. The total size of available land for the first phase and its exact location in Kuala Tanjung would also determine which type of industry should be targeted as a first client.

Considering the current stakeholder relations and communication stream within the JV relating to PoKT land acquisition process, it could be argued currently this variable falls in **Speculation phase**. There are major support coming from the Indonesia central government and ministries in terms of regulatory aid. However due to less transparent communication stream within the JV, considerable amount of uncertainty still lingers within this variable. Real effort need to be done in order to gain more certainty regarding the land acquisition progress and maintaining good relationship with Kuala Tanjung residents. This could be done by simplifying the land acquisition procedure within the JV to some extend. Nonetheless, improvement in terms of communication and coordination could clearly still be done.

In any case, there would be no huge impact towards the project if the land acquisition progress smoothly other than the project shall be completed on time. The damage expected towards the project directly linked to the amount of Kuala Tanjung resident whom reluctant in selling their land. If there are only few inhabitant whom reluctant in selling their land, the port layout could simply be adjusted according to the amount of land bought by the JV. However if there is significant amount of inhabitant whom reluctant in selling their land, the whole project could be delayed or even worse, canceled. Therefore, smooth land acquisition plan in terms of time and amount of area is crucial towards this project success.

#### • Dynamics of relevant government support

The importance of government support towards a port development could be varied greatly depending on location, size, owner, and function of the port. Typically, a fully private port for a specific company would not require government support other than in form of permits and regulations. However, enormous government support would be required for large scale green field port projects, especially when the initiator comes not from private companies. This is due to the fact that large scale green field port project would need to built non-commercial but important basic infrastructure for the port to function in its early stages. These non-commercial basic infrastructure such as breakwaters and roads would not be able to be funded by investor or other private entity since it does not provide any income in the future. Therefore common acceptable practice for such a case is for the owner of the port to pay for the non-commercial basic infrastructure by themselves.

#### Implication towards port of Kuala Tanjung:

Categorized as **Disruptive dominate** since currently significant support from Indonesia central government can be felt and gives positive effect towards PoKT project especially in terms of regulations. Uncertainty mainly comes in terms of how long would this support would be given to the project and do the Indonesian government woulding to provide financial support for the non-commercial basic infrastructure. Suppose that Indonesian government woulding to construct a breakwater or other type of basic infrastructures, significant cost component from the business case could taken out, and might ultimately resulted in a positive business case. On the other hand, if the Indonesian government do not provide financial support, it would place significant burden on the financials of the first phase development of PoKT. The premature solution for such situation would be to build a “just enough” basic infrastructures to minimize CAPEX. However, by doing so PoKT might receive more harm in long-term than its short-term benefit, since “just enough” basic infrastructures might limit the interest of potential business partner.

#### • Relationship with neighbouring ports

Depending on its location, ports could either have competitive or complementary relationship with its neighboring ports. In Europe, it is widely known that PoRA have fierce rivalry with Port of Antwerp and Port of Hamburg. If conducted properly, such competition might benefit most stakeholder through port optimization which then would increase the port logistic standard in the region. On the other hand there is almost no direct competition between Indonesia ports since almost all ports are operated by Pelindos. Moreover due to archipelagic shape of the country, the possibility of ports owned by other country which would compete for the same hinterland only exist in Kalimantan and Papua island. The advantage of the Indonesian model is that the government have the authority to direct each port strategy to suite the necessity of Indonesian citizen living in its hinterland.

However in the case of PoKT, this port would be located in the Malacca strait region where port of Klang and Port of Singapore located. In the transshipment business, PoKT would then face a heavy competition with both of this ports, since these ports are among the top 15 world container port by its cargo throughput (World shipping, 2015). A competitive commercial strategy that is based on efficiency and service towards the port clients would be required to attract the intercontinental shipping liner to berth at the PoKT.

### **Implication towards port of Kuala Tanjung:**

It has **tendency** towards Disruptive dominated rather than Uncertainty dominated, since currently most of the cargo traffic in the North Sumatera region is located in the nearby Port of Belawan. The existence of PoKT would then alter the cargo flow in the region. If the supporting basic hinterland infrastructure connecting both port is not adequate, possible congestion might occur near PoKT. Since both ports are under Pelindo 1 operations, clear division of role between these two port should also be conducted to avoid redundant infrastructure. Having located near metropolitan city of Medan, Port of Belawan would be suitable to focus its infrastructure in transporting people. This might come in form of cruise terminal, marinas, or ferry terminal. All other heavy industrial cargo and activity can be placed in PoKT which is located in the outskirts of the metropolitan city. By doing clear separation of role, both Port could enhance each other properties and bring optimal prosperity towards surrounding region.

Other ports that is worth mentioning in Malacca strait is Port of Klang and Port of Singapore. If PoKT decided to enter container cargo segment as its main source of income, it would face direct competition with the neighbouring port of Klang in Malaysia and port of Singapore. Both of this port are listed in the top 15 largest container port in the world (World shipping, 2015). This situation would put PoKT in significant disadvantage, without sufficient government or external financial support. Because if PoKT wants to attract shipping lines by applying better tariff, the financial burden from just purchasing basic infrastructures in the 1<sup>st</sup> phase development would limit PoKT ability to compete with Port of Klang and Port of Singapore. Therefore for PoKT, building container terminal in the 1<sup>st</sup> phase considered very risky.

### **• Special economic zones**

Special economic zones defined as geographically limited areas administered by single entity which offers any form of incentives to businesses that physically located within the zone (World bank, 2008). In the context of ports, especially large scale green field ports, special economic zones has always been the preferred tool from the government to attract foreign direct investment (FDI). Singapore free trade zone and Sohar freezone for is one few example of special economic zone success in stimulating economic activity in port area. However, it should be noted that special economic zones would not guarantee a economic succes of a region, like where several zones failed in Africa (World bank, 2008). The key of success in apply such special economic zones would be in its location, how its developed and managed. While the root of problem in special economic zones failure is lack of effective coordination between stakeholders involved in the zone and various infrastructure or policy aspects of the zone itself.

### **Implication towards port of Kuala Tanjung:**

Falls in **Speculation phase** because currently PoKT located near Sei-Mangkei special economic zone but not inside it. The incentives provided in this economic zone comes in form of tax holiday, tax allowance, exemption of import duties, and ease of licensing (DNKEK, 2012). The core activities in this special economic zone are palm oil and rubber industry. Discussions are still ongoing between the JV and industrial representative of the Sei Mangkei Economic zone. In general they are supportive with PoKT industrial complex, as long as it does not bring harm to their existing business activities. In principal, PoKT would be the main port of Sei mangkei economic zone while the industry in the zone would provide cargo for the port to be transported. The detailed content of the agreement would be out of scope of this thesis.

### **Port research theme**

Port developments cover broad multi-disciplinary subjects in real practice. In order to systematically identify the implication of the previous identified nine developments towards the future of the PoKT development, the port research themes has been used to pinpoint in which topic of port development might a developments affect the PoKT. These port research themes are a result of extensive literature reviews conducted by Taneja (2013), in which it represents every possible aspect of a port system that could be scientifically observed. First, a literature review has been conducted to gain a list of relevant ongoing developments which are relevant towards the PoKT project. These developments should possess both a significant disruptive effect and level of uncertainty embedded in its nature, although its actual level cannot be measured and decided through the author's qualitative judgement. Next, interviews has been conducted with six experts at the PoRA who have backgrounds in port development (technical), finance, stakeholder management, economics, and commercial points of view. The focus of these interviews was to acquire expert insights in ranking the most relevant developments towards the PoKT, while identifying which port research would be affected by each developments and predict the implication of those developments towards the port's design process. The result of the interviews are compiled in the Table 4. The coloured section cell for each developments indicated the port research themes that are affected by the respective developments. The selection of the affected port research themes was conducted by the combination of the expert interview result and the researcher's own judgement.

Table 4 Impact of each developments on port research themes (source: Author)

No	Variables	Status	Affected Port Research Themes							
			Spatial Studies	Planning and Development	Management and Strategy	Port Performance	Ports in Supply chains	Port Policy	Port operations	
1	Consolidation of Shipping lines	Disruptive dominated	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal						
	Economic impact analysis									
2	Land acquisition process	Speculation phase	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal						
	Economic impact analysis									
3	Multi-National Partnership	Speculation phase	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal						
	Economic impact analysis									

No	Variables	Status	Affected Port Research Themes							
			Spatial Studies	Planning and Development	Management and Strategy	Port Performance	Ports in Supply chains	Port Policy	Port operations	
4	International regulation and standards	Speculation phase	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal Economic impact analysis						
5	Local regulation and legal permits	Uncertainty tendency	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal Economic impact analysis						
6	Relevant government support	Disruptive dominated	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal Economic impact analysis						

No	Variables	Status	Affected Port Research Themes							
			Spatial Studies	Planning and Development	Management and Strategy	Port Performance	Ports in Supply chains	Port Policy	Port operations	
7	Special Economic Zones	Speculation phase	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal						
	Economic impact analysis									
8	Neighbouring Ports	Disruptive tendency	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal						
	Economic impact analysis									
9	Port related technology development	Disruptive dominated	Spatial developments	Demand forecasting	Port Authority	Port Efficiency	Inland Logistics	Governance & reform	Seaside operations	
			Trade patterns	Masterplanning	Terminal Operator	Port Competition	Port Logistics	Terminal Operator	Terminal Operations	
			Port Strategy	Design of Infrastructures						
			Port- city relationships	Financing & risk management						
				Project appraisal						
	Economic impact analysis									

## 2.3 Scenario building

Scenarios defined as plausible description on how the future might envelop based on consistent relations, drivers, and key parameters affecting the observed system (Metz, Davidson, Bosch, Dave, and Meyer, 2007). In the adaptive port planning framework, scenarios were developed based on the identified uncertainties affecting the port. In the context of the PoKT, the uncertainties would be the aforementioned nine developments in the previous chapter. The method that are used in the scenario building is based on modified “Scenario Matrix” which are developed by Roland Berger Research unit (Wulf, Brands, and Meissner, 2010).

**First**, the two key uncertainty factors would need to be identified. These two key uncertainties would have a significant impact on PoKT performance for the next 30 years. The window period of 30 years has been selected to standardize the study with the previous PoRA study to enable internal direct comparison. Based on the qualitative analysis on the cause and effect of each identified nine developments, it is concluded that “North Sumatera Economic Growth” and “North Sumatera Protectiveness level” would be the two key uncertainty relevant to PoKT. **Second**, an influence diagram has been developed to elaborate on how the identified nine developments would effect the two key uncertainties. In order to complete the whole cause and effect relationship in the diagram, three additional uncertainties would need to be introduced. These additional uncertainties plays major role in how the the future might envelop for PoKT. They are “Population growth”, “Information & communication technologies (ICT)”, and “Renewable energy development”. The influence diagram would be presented in the next page, while the cause and effect of each developments and uncertainties towards the two key uncertainties would be explained as follows:

- North Sumatera Economic Growth

North Sumatera Economic Growth is directly influenced by several factor such as population growth, local regulation and government, the performance of Sei Mangkei economic zone, relationship with Port of Belawan and to some extend by the coalition of the shipping line developments. The actual relationship between the coalition of shipping line developments with the north sumatera economic growth would be debatable. As some might view that the coalition of shipping lines as the effect of a region’s economic growth while the others might see the developments as the stimulator of a region’s economic growth. This debate might seem similar with the classic debate of “Do a ship follows the cargo or the cargo follows the ship?”. The believe that the JV take would take would heavily impact the approach in decision making and the future of PoKT. For instance, if the JV believes that “The ship follows the cargo” or the coalition of shipping line as an effect of a region’s economic growth, the JV would not design the facilities of the PoKT by using the largest vessel dimension. Because, the JV would take a proactive approach and design terminals only to serve the vessels which would most likely berth at the PoKT. This view is preferable in the context of port planning. Because, even though it is widely acceptable that a port developer should always follows the port related industries developments (i.e: coalition of shipping lines), their judgement should not be dictated by it. The identification of developments should only serve as an insight to develop preemptive actions and strategies to win against their rival ports. On the other hand, if the JV believe that “The cargo follows the ship,” or the coalition of shipping line as a stimulator of a region’s economic growth, the JV would design the facilities of the PoKT following the world largest vessel dimension. In this assumption, the JV would act reactively which is not preferable.

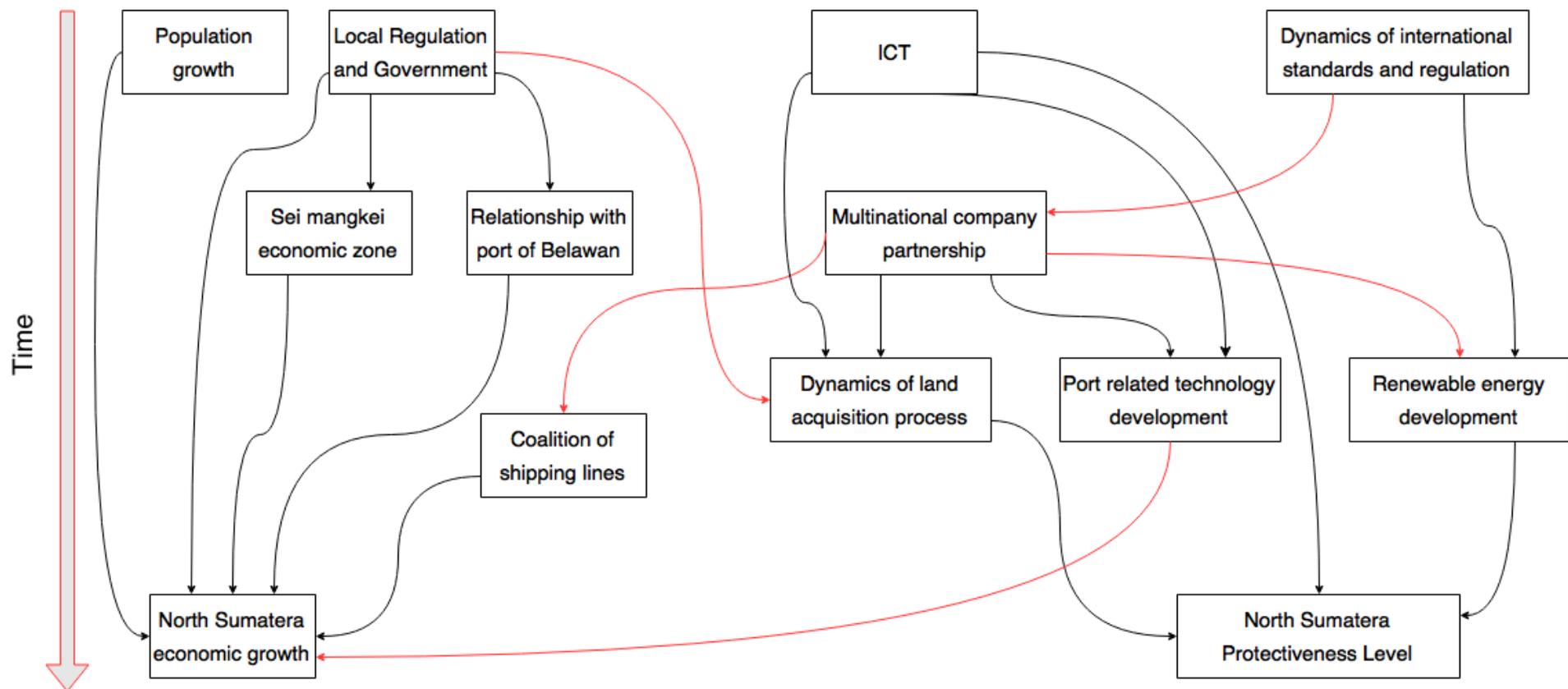


Figure 12 Illustrative diagram between developments and uncertainties relevant to Port of Kuala Tanjung (Source: Author)

- North Sumatera Protectiveness level

North Sumatera Protectiveness level defined by the tendency of North Sumatera and other related government to be willingly participate in international market (in form of trading or open competition between local and international companies) or seclude from the international market itself by using protective policies. There is no telling in how a North Sumatera would response towards global market condition in the next 30 years as it would depend on various factors such as ICT development in the country, energy resources, and politics which is reflected by “local regulation and government support” in the influence diagram. There will be strong feedback relationship between protectiveness level with the dynamics of land acquisition process on which the relationship would depends on each case by case. In this study, a case of Bali in Indonesia would be used as an example. In 1970s Indonesian government decided to to develop Bali as center of international tourism (Hakim, Kim, & Hong, 2009). Through smooth land acquisition, local inhabitant can feel the positive effect of foreign participation in the region in form of investment or tourists. This good land acquisition eventually leads to more open balinesse society towards foreign participation in their region. Untill in 2002, “Ajeg Bali” an movement in preserving bali original identity was initiated due to accumulated social conflict, bombings, and damage to natural resources (Allen & Palermo, 2006). In this brief example the dynamics and relationship between land acquisition process and protectiveness level of a region has been demonstrated.

**Third**, scenario descriptions would be constructed based on two key uncertainties which are relevant to PoKT. The four constructed scenarios are illustrated in Figure 11, with the *Social Oasis* being the most optimistic scenario.

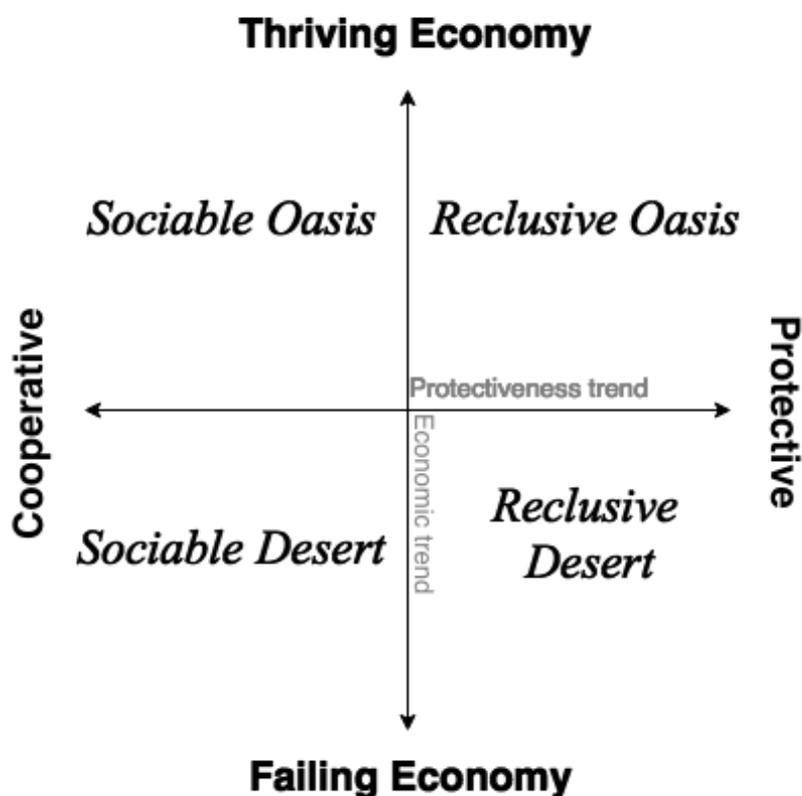


Figure 13 Port of Kuala Tanjung Scenario Matrix (Source: Author)

- Reclusive Oasis

Due to superb local authority and coordination with national government, stable and healthy political situation in North Sumatera preserved for the next 30 year. Sei mangkei economic zone were able to generate its full economic potential and provide significant amount of jobs to already growing North Sumatera population. Pelindo 1 and all relevant Indonesia government were able to diversify PoKT and Port of Belawan key competence which result in mutual benefit for both porth. Terminals and jetties which are designed to serve world largest vessel were able to be fully utilized since cargo traffic in PoKT is relatively stable. North Sumatera economic growth continued to rise as forecasted.

However, due problematic land acquisition unsatisfied citizen would started to use social media to raise awareness regarding the negative effect of foreign participation business partner to their local region. The discussion would grow in time if not handled with proper stakeholder management. Numerous debate in academic, casual, and formal setting would occur with PoKT as the central attention. It is worth noting that in this scenario, renewable energy technologies has achieved commercial stage, enabling North Sumatera government to purchase and install them in their region. Eventually, the debate on foreign participation in regional business activities would reach its mature stage. The North Sumatera government can no longer neglect the ongoing society developments and must decide their policy course. After considering healthy economic condition in North Sumatera, availability of renewable energy sources, and public opinion, they would decide on taking protective policy measures.

- Reclusive Desert

Continuous political conflict and other negative managerial factor preserved for the next 30 year lead to poor government performance in various sector in North Sumatera. Sei mangkei economic zone becomes a lost cause and there would be thousands of unemployed citizen which suppose to be working this special economic zone. Due to mismanagement and lost of coordination within all related government agencies, Port of Belawan and PoKT falls in competitive situation which put both port at disadvantage. Terminals and jetties which are designed to serve world largest vessel were obsolete since to big vessel coming to PoKT due to low demand. North Sumatera economic growth would plummeted which contradicts most economic forecast.

The difficult economic situation combined with problematic land acquisition, placed a scar to North Sumatera citizens. Powered by internet and advanced renewable energy technologies a self-sustainable campaign started by the citizens to recover North Sumatera economy. The society becomes more reclusive and protective towards their local commodity to ensure their well-being. Acknowledging this campaign, the North Sumatera government started to publish protective policies.

- Sociable Oasis

Due to superb local authority and coordination with the national government, stable and healthy political situation in North Sumatera preserved for the next 30 year. Sei mangkei were able to generate its full economic potential and provide significant amount of jobs to already growing North Sumatera population. Pelindo 1 and all relevant Indonesia government were able to diversify PoKT and Port of Belawan key competence which result in mutual benefit for both porth. Terminals and jetties which are designed to serve world largest vessel were able to be fully utilized since cargo traffic in PoKT is relatively stable. North Sumatera economic growth continued to rise as forecasted.

Moreover, successful land acquisition creates a harmonious relationship between PoKT and the citizen. Public in general started to realize the positive effect a foreign business participation could bring to the region. PoKT becomes the proud icon in the region and really becomes an example of a good international port partnership in Indonesia. Harbouring on PoKT success, the government of North Sumatera and all other related state own enterprises becomes more cooperative with foreign business partnership opportunities.

- Sociable Desert

Continuous political conflict and other negative managerial factor preserved for the next 30 year lead to poor government performance in various sector in North Sumatera. Sei mangkei economic zone becomes a lost cause and there is thousands of unemployed citizen which suppose to be working in this special economic zone. Due to heavy mismanagement and lost of coordination within all related government agencies, Port of Belawan and PoKT falls in competitive situation which put both port at disadvantage. Terminals and jetties which are designed to serve world largest vessel were obsolete since to big vessel coming to PoKT due to low demand. North Sumatera economic growth would plummeted which contradicts most economic forecast. In response to this economic disaster, North Sumatera government and PoKT JV started multiple program to attract foreign investment under the supervision of the national government. This cooperation was able to be done due to successful land acquisition in the region which turns into supportive public opinion and good relationship between all government related agencies with PoKT JV. Only few renewable energy technologies installed due to financial reason

**Fourth**, the effect of each scenario towards the cargo flow in PoKT for the next 30 years would be described in Table 5. For simplicity, a coarse qualitative analysis has been conducted in measuring the impact of scenario to the cargo segment. The selection of cargo group written in Table 5 is based on the feedstock required to produce each group and relationship of the corresponding cargo group with a North Sumatera prosperity level.

The construction & manufacture group defined as all commodities that are required in infrastructure or vechicle construction process. Most cargo in this group are metal based with some agregat or chemicals. The volatility of this group would have strong relation with the economic state of North Sumatera. Protectiveness level would reduce number of export and transshipment commodity in this segment, however import cargo flow would be mainly influenced by North Sumatera economic condition, therefore economic condition still have stronger influence compared to protectiveness level.

The food & essentials group defined as all consumable commodities that are served as human primary needs, delivered as feedstock or finished product. Most of cargo in this group are consumables. This commodities might come in form of fruits, grains, medicine, local food product, and palm oil. This group wil have relatively stable demand regardless of the two key uncertainties compared to the other cargo group driven mainly by population growth of North Sumatera.

The electronic & fashions defined as all commodities that that are served as human secondary/tertiery needs, delivered as feedstock or finished product. Most cargo in this group are non-consumable. Computers, gadgets, jewelry, textiles, are one of few examples of cargo in this group. The primary influencer of this cargo group is North Sumatra economic condition to reflect the purchasing power of the people in the regiion and protectiveness level to reflect to social product preference in the region.

The conventional fuels group defined as coal, crude oil, and natural gas. The main influencer of this cargo group is the North Sumatera economic growth. These conventional fuels are not just threatened by the existence of renewable energy sources but also by bio-based chemical product as an alternative for their downstream products. Coal having the least versatility compared to crude oil and natural gas would be the most volatile cargo commodity in this group. By having several alternative of downstream chemical products, natural gas would have medium security in cargo trade in case the third industrial revolution does happen. Finally crude oil would still have relatively stable cargo flow due to its vast variety of chemical downstream product. Moreover, since there is still no known bio-based alternative for aromatics chemical downstream product produced from crude oil, the demand for this cargo could be expected relatively stable (excluding global oil price from the cause-effect analysis).

*Table 5 Scenario impact on cargo flow in Port of Kuala Tanjung*

Scenario	Construction & Manufacture			Food & Essentials				Electronic & Fashions			Conventional Fuels	
	DB	BB	C	DB	BB	C	LB	DB	BB	C	DB	LB
Reclusive Oasis	2	2	1	1	1	1	1	1	1	1	1	1
Reclusive Desert	-1	-1	-2	2	-1	-2	2	-1	-1	-1	0	0
Sociable Oasis	1	1	2	1	2	2	1	2	2	2	2	2
Sociable Desert	-1	-1	-1	1	0	-1	1	-1	-1	-1	0	0

DB: Dry Bulk (i.e: Iron ore, Grains, Silicon pellets, Coal)

BB: Break Bulk (i.e: Cement, Paints, Packaged goods, Textile)

C : Containers (i.e: Special machineries, ready to use products)

LB : Liquid Bulk (i.e: Palm oil, LNG, Crude Oil)

-2 : Substantial negative effect (> 25%)

-1 : Moderate negative effect (10 – 20 %)

0 : Relatively stable ( $\pm$  5%)

1 : Moderate positive effect (10 – 20 %)

2 : Substantial positive effect (> 25%)

## 2.4 Definition of Success

The definition of success of the 1<sup>st</sup> and 2<sup>nd</sup> part of the reseach after taking into account the developments and scenarios in the previous sections is as follows:

**1<sup>st</sup> Part Definition of success:** The masterplan enables the port to adapt its strategy, function, and layout depending on the necessity of the future condition

**2<sup>nd</sup> Part Definition of success:** The 1<sup>st</sup> phase layout is able to accommodate future phases under various circumstances while providing added value into the region.

## 3 Port of Kuala Tanjung Masterplan

### 3.1 Port Masterplanning

Port masterplanning is a complex multidisciplinary task which requires broad range of expertise in the making. Port engineer task is to manage and obtain those expertise at perfect time of the project (Lighterinen & Velsink, 2012). Each port masterplanning process starts from Cargo demand forecast as its based assumption. Traditional approach would limit number of scenarios accounted in the design process. Flow diagram of the traditional port planning decision process presented in Figure 14 **Error! Reference source not found..** Thus, the resulting port masterplan can only guarantee to works if the correct cargo forecast occur in the future. This approach of port planning, might lead to numerous regret decision in the future. Regret decision means that development of certain infrastructure in the port would hinder/slow down the development of the next phase of port infrastructure.

More modern and reliable approach would be to apply Adaptive Port Planning framework. This approach would result in a robust port masterplan, which able to face multiple scenarios in the future. Robustness test can also be conducted to give an idea about how robust is the produced masterplan compared with other alternative. By doing so, optimization regarding which port masterplan can perform well in most plausible future scenario can be done in quantitative way.

#### 3.1.1 Port Governance model

There are four known port governance practice in the world. Each model reflects the ideology of the port owner/developer. Even though nowadays up to 88 out of 100 highest performing container ports belongs to landlord governance model (Lighterinen & Velsink, 2012). Brief explanation regarding the differences of each port governance model are as follows:

##### **Service port**

In service port governance model terminal operator, port regulator, harbor master and all related port activity are being managed by one institution often called the port authority. This model commonly done in developing countries where there are no port competition for the same hinterland. Due to absence of free competition, productivity in service port often much lower than landlord port model

##### **Tool port**

Tool port can also be viewed as a hybrid between service and landlord port model. In this model port authority still provide all basic facility including *ship-to-shore* (STS) crane. The cargo handling activities however, conducted by private companies or in partnership with the port authorities. This model can be found in medium size port.

##### **Landlord port**

Landlord port currently deemed as the most favourable port governance model by both private companies and port authorities. This model implies clear role separation between port authority and terminal operator. Port authorities responsible for constructing and maintaining basic key infrastructure and water areas. Terminal operators (private companies) responsible to provide cargo handling equipments and conduction day-to day cargo handling activities. By doing this, higher port efficiency level can be achieved since the terminal operators need to be stay competitive with each other to attract cargo to the port.

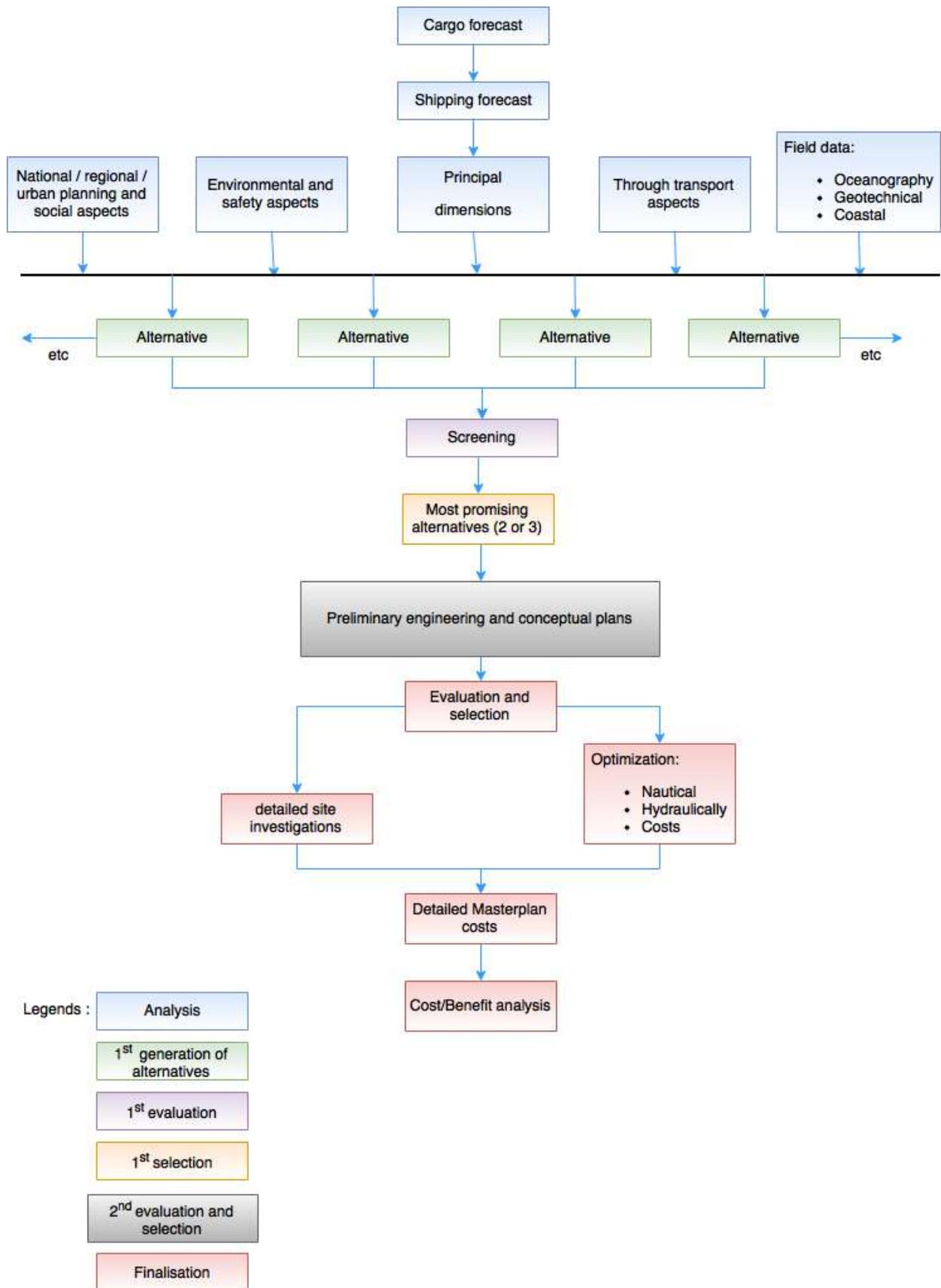


Figure 14 Traditional port design process (Ligheringen & Velsink, 2012)

### 3.1.2 Stakeholder management

Stakeholders defined as set of individuals or organization which affected by a project, have interest towards it, and have a power to influence its outcome (IFC, 2007). Considering PoKT is a large scale and long-term project, there would be multiple number of stakeholder with diverse background involved. Therefore, stakeholder management would be crucial in determining PoKT success in the long term. According to IFC (2007), there are eight factor which influence good stakeholder engagement, namely: Information disclosure, Stakeholder consultation, Negotiation and partnerships, Grievance management, Stakeholder involvement in project monitoring, Reporting to stakeholder, Management functions, and Stakeholder identification and analysis.

### 3.1.3 Environmental and Societal Impact Assessment (ESIA)

Environmental and Social Impact Assessment (ESIA) is a comprehensive document of a Project's potential environmental and social risks and impacts" (IFC, 2007). An ESIA is prepared for large infrastructure greenfield development to ensure its sustainability both environmentally and socially. The key process elements of an ESIA generally consist of (Corsi, Oppio, & Dendena, 2015):

- (i) initial screening of the project and scoping of the assessment process
- (ii) examination of alternatives
- (iii) stakeholder identification (focusing on those directly affected) and gathering of environmental and social baseline data
- (iv) impact identification, prediction, and analysis
- (v) generation of mitigation or management measures and actions
- (vi) significance of impacts and evaluation of residual impacts; and
- (vii) documentation of the assessment process (i.e., ESIA report)

3.2



Figure 15 Key components in stakeholder management (IFC, 2007)

## Pelindo 1 and Port of Rotterdam Joint Venture Overview

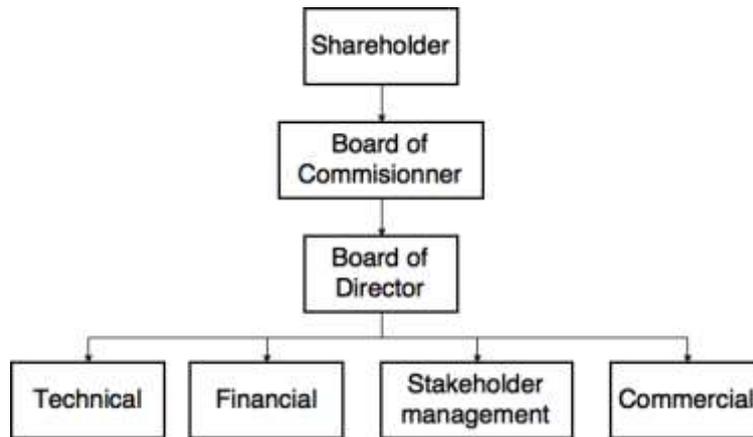


Figure 16 Port of Kuala Tanjung JV organogram (source: Interview)

During the planning stage of PoKT, team of experts from Pelindo 1 and PoRA were combined and organized into four working team as listed in Figure 16. The member of each working team and the boards are not fixed as the project is highly dynamic. However the shareholder would always remain as the highest decision maker in the JV represented by the CEO of both Pelindo 1 and PoRA.

### Difference in port governance model

The main difference in Pelindo 1 and PoRA lies in its port governance model. As being explained previously in chapter 1, prior to 2008 Indonesia port (Pelindo) adopted service port model. With the establishment of “Otoritas Pelabuhan” in 2008, some authority which previously held by Pelindos are being transferred into the new entity. The Otoritas pelabuhan mainly have a regulation role while Pelindos in operation. For simplicity, Pelindo 1 would be seen as a service port while Port of Rotterdam as a landlord port. Further breakdown the difference in authority designation between Indonesia (Pelindos) and the Netherlands (PoRA) presented in Table 6 below.

Table 6 Difference in authority designation between Indonesia and The Netherlands (KTPO, 2017)

	Indonesia								The Netherlands					
	Public Entities (including State Owned Enterprises)							Private Entities	Public Entities					Private Entities
	Min. of Transport	Port Authority	Harbor Master	Pelindo I	Municipality	Customs	Other (police, fire brigade etc.)		Port/ Port Authority & Harbour master	Ministry of Infrastructure	Environmental Agency (DMCR)	Municipality	Customs	
Commercial														
Planning														
Infrastructure														
Nautical Safety & Security														
Regulation														
Stakeholder Mgmt.														
Marine Services & Utilities														
Supra-structure														
Labor														
Logistics														
Industry														
Law Enforcement														

### 3.3 Previous masterplans

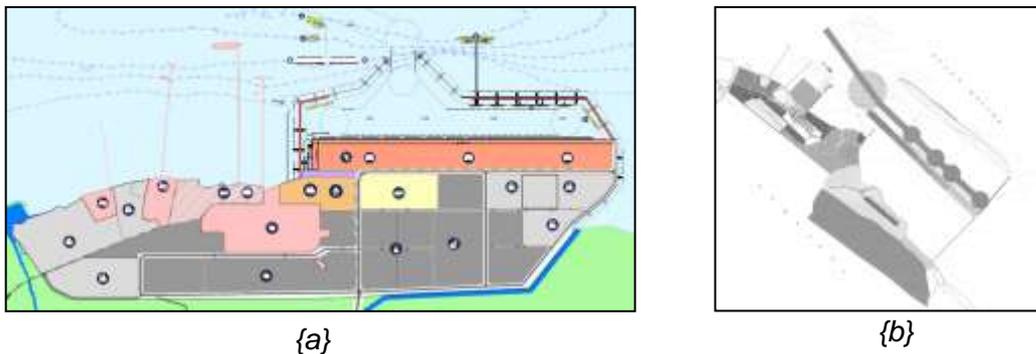


Figure 17 Previous Port of Kuala Tanjung masterplans  
(Source: KTPO {a}, 2017; KP 148 {b}, 2016)

Various alternative of PoKT masterplans have been drafted for the past three years (KTPO, 2017; KP 148, 2016; Royal Haskoning DHV, 2014). These masterplans were used to visualize the end picture of PoKT preferably in the next 30 to 50 years. In general, the previous masterplans divided into two type, a land-based port and an offshore port. In a case of land-based port, the majority of the Port development would take place in the mainland. The biggest advantage of these type masterplan is the laden availability of land for future developments (i.e: Industrial clusters). On the other hand, an offshore port masterplans orient PoKT developments into deep water area. By doing so, the dredging cost of the port can be considerably reduced while maintaining accessibility for world largest ships. An example of each type of the previous PoKT masterplan can be found in Figure 17, while the full sized image can be found in the Appendix A.

For the purpose of this study, the emphasize would be given on developing an adaptive masterplan based on the masterplan developed by PoRA. All assumption being used later in applying the adaptive port planning framework would be using this masterplan as its starting point. The PoRA masterplan is chosen as the base masterplan, because it has the closest attribute with the study objective, compared with other masterplan in terms of robustness and self-sustainability. By making use of circular economy concept provided by industrial cluster in its hinterland, this port masterplan would able to secure PoKT cargo flow regardless of external economic condition (i.e: wars, global economic conflict, etc). Feedstocks for the industrial cluster which are unavailable in the local region would be imported while the excess product cluster would be exported making a cargo flow system relatively independent from external influence compared to transshipment terminals. It should be noted that the catalysing-effect concept is not relevant to be discussed in masterplans as its main purpose is to ease the next step development. By definition, masterplans are the end picture of a development (in a traditional planning approach), therefore making catalysing-effect concept unsuitable to be paired with it.

In the context of adaptive port planning, port masterplans would always be evolving periodically to adapt with global developments. Continuous monitoring in the validity of a Port masterplan with current developments is a routine task in adaptive port planning. Therefore in an adaptive port planning, masterplans were not treated as a fixed and rigid visualization of future, but as a dynamic goal in achieving ideal port in the future according to the planners perspectives. In that regard, every port masterplan would have an expiry date in adaptive port planning, which needs to be recalibrated with existing condition and future developments to maintain its quality. Another important element in an adaptive port planning is to maintain flexible allocation of land use in its stage of developments, or often referred as sectoral approach.

## 3.4 Adaptive port of Kuala Tanjung Masterplan

### 3.4.1 Basic assumptions in Port of Kuala Tanjung

Based on the PoRA masterplan and all accessible information related to PoKT project obtained from the working teams in the JV, the basic assumptions and the assumptions that are going along with them, which would be used in developing the adaptive port masterplan has been formulated. These assumptions are listed as the “driving force” in Table 7. It is worth noting here that, since negotiations and governmental lobbying is still on progress at the time this study took place, the assumptions stated here is still rather volatile. However, they are indeed classified as the “most likely” realization of the future according to the experts in JV. This assumptions were compiled into list of driving forces which impact decision making in drafting the PoKT adaptive masterplan.

*Table 7 Driving forces and its implications to Port of Kuala Tanjung masterplan*

Major driving forces	Vulnerabilities and opportunities
Physical Infrastructure layer	
<ul style="list-style-type: none"> <li>- Possibility in providing multiple source of electricity (Coal, gas, renewable, etc.)</li> <li>- Cheap coal with more environmentally friendly electricity generation technology</li> <li>- Gas field located nearby</li> <li>- Location in strait might provide sufficient and sustainable current speed for electricity generation</li> </ul>	The robustness of electricity supply in the port area
<ul style="list-style-type: none"> <li>- Centralized electricity cluster provide minimum maintenance cost, higher land utilization but lower reliability and network coverage</li> <li>- Scattered electricity plant within every cluster provide higher reliability and network coverage with additional maintenance cost</li> </ul>	Long-term success in determining the electricity network configuration
<ul style="list-style-type: none"> <li>- Location of the breakwaters</li> <li>- Realization of cargo flow throughput which needs to be handled in sheltered area (i.e: container or breakbulks)</li> </ul>	Sheltered port basin size is too small or big
<ul style="list-style-type: none"> <li>- The location of existing jetty belonging to existing industry</li> <li>- Access channel dimension, location and orientation</li> <li>- Existence of Bah Bolon river which bring more sediment to the basin</li> </ul>	The location of the breakwaters
<ul style="list-style-type: none"> <li>- Additional sedimentation in port basin</li> <li>- Lost of land slot due to the natural river route</li> </ul>	Long-term effect of River Bah Bolon engineering/intervention (Flood upstream or river degradation)
<ul style="list-style-type: none"> <li>- Using common attributes based on today's technology as consideration</li> </ul>	Industrial cluster classification method

Major driving forces	Vulnerabilities and opportunities
<b>Physical Infrastructure layer</b>	
<ul style="list-style-type: none"> <li>- Expensive non-commercial basic infrastructures needed to fully realize its potential</li> <li>- No source of income in early stage</li> </ul>	Financial condition to arrive in its mature/stable condition
<ul style="list-style-type: none"> <li>- The highly uncertain availability and timing of industrial client that willing to sign contracts</li> <li>- The JV industrial client preference according to the masterplan</li> <li>- Commercial potential of the cargo produced by the Industrial client</li> </ul>	Position and size of the industrial clusters
<ul style="list-style-type: none"> <li>- Circular economy within and industrial cluster provide risk minimum cargo flow</li> <li>- Cargo flow for the industrial activity would also generate risk minimum port due income source for Port of Kuala Tanjung</li> <li>- the ability of port authority to decide and locate type of industry in specific land slot within the port</li> </ul>	Resilience port, relatively independent from global economic and political situation
<b>Operations and Management layer</b>	
<ul style="list-style-type: none"> <li>- Strategic decisions are to focus in realizing port of Kuala Tanjung as a “stand-alone” massive port, therefore missing the “best practice” and policies in how link it with other port in Indonesia “Tol Laut” network</li> </ul>	The port compatibility in supporting Indonesia Tol Laut program
<ul style="list-style-type: none"> <li>- Existing industries which are located inside Port of Kuala Tanjung fully developed area were not willing to be fully integrated with the port.</li> <li>- Uncoordinated, opportunity driven industrial client placement</li> </ul>	The utilization level of shared facilities (roads, pipelines, railroads, terminals, etc.)
<ul style="list-style-type: none"> <li>- Huge domestic market size in Indonesia maily due to 250 million population</li> <li>-Existence of alumunium smelter as feedstock for multiple alloy product</li> <li>- Existence of palm oil industry as feedstock for multiple consumable product</li> <li>- Existence of rubber industry</li> <li>-Sei mangkei economic zone located nearby</li> </ul>	The success rate of integrated port industrial complex
<ul style="list-style-type: none"> <li>- Both port of Kuala Tanjung and port of Belawan are under Pelindo 1 authority</li> <li>- Port of Belawan located near metropolitan city and tourist attraction while Port of Kuala Tanjung located relatively far from the city and tourist attraction</li> </ul>	The relationship with neighbouring port which share the same hinterland (port of Belawan)

Major driving forces	Vulnerabilities and opportunities
Operations and Management layer	
<ul style="list-style-type: none"> <li>- Both port already quite mature financially and have secure position in terms of container cargo handling</li> <li>- Direct competition in container handling with these ports could possibly resulted in price war which puts significant financial burden in Port of Kuala Tanjung</li> </ul>	Competition with non-Indonesian port in the region
<ul style="list-style-type: none"> <li>- Minimum competition within the port industrial cluster</li> <li>- Unclear regulation or incentives regarding the collaboration/competition between industrial company in the Port industrial cluster</li> </ul>	Industrial client participation in the port Industrial cluster's circular economy cycle
<ul style="list-style-type: none"> <li>- Pelindo 1 has the expertise of service port governance model (broad field) and knowledge of Indonesia local regulation and customs</li> <li>-Port of Rotterdam authority has the expertise of managing the largest landlord port (specific field) in Europe</li> </ul>	Autonomous project organization
Products and services layer	
<ul style="list-style-type: none"> <li>-Existence of business activity which does not generate throughput and do not use land for a long time (i.e: Offshore platform maintenance)</li> </ul>	New source of income other than leasing fees and port dues

*Table 8 Some wildcards and their impacts*

Wildcards	Impacts
Construction and usage of Thailand "Kra" canal commercially successful	Vessel traffic passing Malaka strait could be reduced to half, more strict competition in transshipment handling with competitor ports would occur
China "One belt one road" policy successfully implemented	Significant change in Asia to Europe cargo flow, strategic analysis and decision need to be conducted

An additional major assumption which also needs to be written are as follows:

- Pelindo 1 and PoRA JV continues to manage PoKT together through remote project organization
- The PoKT adaptive port masterplan would be relevant for the next 30 year as long as there is no significant changes in the governing nine developments (Chapter **Error! Reference source not found.**) and two key uncertainties (Chapter 2.3)
- The total land-side area development which have been estimated to be 2.650 ha assumed to be sufficient for the next 30 year and served as land boundary in the new adaptive port masterplan.

### 3.4.2 Increasing flexibility and robustness of each alternative

In order to increase the flexibility and robustness of each alternative, variety of actions has been proposed. These actions are divided into mitigating, shaping, seizing, and hedging actions as explained in page 9. For ease of reading, the definitions of each actions provided below:

- Mitigating Action: Reduce the probability of vulnerabilities to happen in a quite certain event
- Shaping Action: Shape future developments towards preferred realization
- Seizing Action: Seize opportunity for a fairly certain event
- Hedging Action: Spread risk for a highly uncertain event

Through qualitative analysis and discussions with PoRA experts that participated in PoKT working teams, “vulnerabilities and opportunities” has been identified and listed in Table 7 which are relatively certain or not. Next, the adaptivity of each “vulnerabilities and opportunities ” would be improved by applying the four type of actions as mentioned above. The list of appropriate actions for each type of alternative was listed in Table 9 for the relatively certain alternatives and in Table 10 for the uncertain alternatives as follows :

*Table 9 Relatively certain event and the appropriate response to them*

Vulnerabilities and opportunities	Mitigation (M), Shaping (SH), and Seizing Actions (SZ)
The utilization level of shared facilities (roads, pipelines, railroads, terminals, etc.)	SH: Use widely accepted distribution network technologies SH: Apply attractive commercial, pricing, and shared facilities down time due to maintenance strategies M: Decide as early as possible the relationship between the existing industrial company with Port of Kuala Tanjung
The success rate of integrated port industrial complex	SZ: Port of Kuala Tanjung should be developed as fast as feasibly possible to capture the growing Indonesia market demand momentum SH: Strive to realize a perfect competition market in the industrial cluster to promote fairness and higher efficiency provided by the industrial tenants SH: Regularly monitor the performance of the terminal operators to maintain cargo handling quality SH: Ensure seamless collaboration between industries incorporated in an industrial cluster’s circular economy and the terminal operators to promote overall port robustness
The relationship with neighbouring port which share the same hinterland (port of Belawan)	SZ: Make port of Belawan focused on people transport such as cruise and ferries while port of Kuala Tanjung in industrial activities SH: Gradually shift port of Belawan industrial related cargo flow to port of Kuala Tanjung SH: Start to invest more in people transport facilities in port of belawan such as cruise terminal and Ro-Ro terminal

Vulnerabilities and opportunities	Mitigation (M), Shaping (SH), and Seizing Actions (SZ)
Industrial client participation in the port Industrial cluster's circular economy cycle	<p>SH: Make a clear and abiding contract regarding the industrial company participation in its respective industrial cluster's circular economy cycle</p> <p>SH: Promote internal competition between industrial companies of a same type to stimulate perfect market condition</p> <p>M: Construct "Internal competition watch department" to regulate and monitor industrial companies interaction with each other</p>
Financial condition to arrive in its mature/stable condition	<p>SH: Each phase of Port of Kuala Tanjung should be commercially feasible on its own, independent from the other phase of development</p> <p>SH: Build a succesfull first phase development to attract future client and investors</p> <p>M: Request for government support/partnership especially in funding the non-commercial basic infrastructure. Offer either share, dividen, other beneficial financial product in the future for the government in return.</p>
Autonomous project organization	<p>SZ: The remote project organization should act as entirely new entity separated from Pelindo 1 and Port of Rotterdam authority organization. It should be established solely to regulate, manage, and plan Port of Kuala Tanjung within the framework of landlord port model</p> <p>SH: Clearly separate strategic decision making and operational decision making authority between the remote project organization and the shareholders</p> <p>SH: Clearly define which item belongs to strategic decision making and operation decision making criteria</p>
New source of income other than leasing fees and port dues	<p>SZ: Invite offshore repair yard and other related industries in Batam for discussions and find out new business plan which would benefit both party</p> <p>SH: Conduct study to brainstorm new business model or game plans to utilize the growing coastal renewable energy (tidal, current, wave, thermal and salt gradient) market into the Port of Kuala Tanjung business model</p>

Table 10 Some uncertain event and the appropriate response to them

Vulnerabilities and opportunities	Hedging (H) and Shaping (SH) Actions
The robustness of electricity supply in the port area	<p>SH: Invest in more environmentally friendly, renewable, and reliable energy source in the long-term</p> <p>SH: Promote the use of gas fired electricity plants over coal fired electricity plants whenever possible</p> <p>H: Limit the use of Coal fired electricity plants. These plants should only be built/operated in early phases of Port of Kuala Tanjung development only, mainly due to financial reason and absence of other reliable yet cost-effective energy source</p> <p>H: Research in efficient, multi-fuel sourced/hybrid electricity plants</p>
Vulnerabilities and opportunities	Hedging (H) and Shaping (SH) Actions
Long-term success in determining the electricity network configuration	<p>SH: The electricity network should be built in such away that it is possible to easily relocate/reroute them</p> <p>H: Built the electricity plants as late as possible. Built them only when it is clear that the current electricity grid is unable is not enough (could be due to capacity or network coverage radius reason).</p>
Sheltered port basin size is too small or big	<p>SH: Relocate breakwaters if necessary</p> <p>H: Place the right side breakwater (the one which is furthest away from existing industries) as late as possible in the development</p>
The location of the breakwaters	<p>SH: The breakwater should be built in modular system to enable more flexibility in terms of layout and size in the future</p> <p>H: Build the breakwaters as late as possible, only when container and breakbulk vessels start to call to the port.</p>
Long-term effect of River Bah Bolon engineering/intervention (Flood upstream or river degradation)	<p>SH: Use building with nature approach when designing the river intervention</p> <p>H: Do not place hazardous/toxic industry near the original and altertered river route to avoid contamination in case of disastorous event occur</p> <p>H: Communicate with local authorities upstream the river upstream to collaborate in preserving Bah Bolon River well being. Construct independent river monitoring committee if necessary.</p>

Vulnerabilities and opportunities	Hedging (H) and Shaping (SH) Actions
Industrial cluster classification method	SH: Categorize the industrial cluster into alloys, bio-based, and petrochemical cluster due to their distinct required sea-side terminal facilities, feedstock, and usability in the market. H: The effect of industrial clustering should only be in determining their location to optimize shared facilities utilization. For industries that do not require shared facilities or do not fit in the circular economies concept must always be able to be relocated.
Position and size of the industrial clusters	SH : The masterplan layout for the next 30 year should be drafted based on the location of the first three established industrial cluster to enable optimum flexibility. H : Conduct periodical market study on each cargo segment to update area demand required for each industrial cluster
Resilience port, relatively independent from global economic and political situation	SH: Invest in irreplaceable industrial commodities for the next 30 year such as alloy metals (ferro-alloy, manganese alloy, etc.) H: Limit the investment on replaceable petro-chemical products such as olefins (could be replaced by corn starch or other agro-waste)
The port compatibility in supporting Indonesia Tol Laut program	H: Involve Indonesian government representative in regular meeting (i.e: every 3 months) specifically designed to coordinate Port of Kuala Tanjung with the other Indonesian port that are included in “Tol Laut” program SH: Conduct a balanced campaign between Port of Kuala Tanjung as “The Best Port Industrial Complex in Asia” with Port of Kuala Tanjung as “The backbone/pioneer of Tol Laut network”.
Competition with non-Indonesian port in the region	SH: Partnering with world class container terminal operator to attract major shipping alliances H: Do not use container cargo segment as the main source of income to avoid substantial loss

Among the list of event presented in table 9 and 10, a few most important event has been selected, which is strongly related to the research objective, realizing a self-sustainable first phase PoKT development with catalysing effect. This selection was conducted by the author’s own qualitative judgement. These most important “Vulnerabilities and opportunities” are indicated by the light blue shade in the table. The reason in selecting these most important “Vulnerabilities and opportunities” explained as follows:

- Tough financial condition to arrive in its mature/stable condition:

Just as other promising, massive, infrastructure developments, PoKT need to be built in phases. The success of the first phase development in this regard would be vital to determine whether PoKT can live up to its potential or just become a wishful thinking. Commercial, environmental, and social success must be achieved to satisfy the goal driven, value driven, and profit driven stakeholders. Only by achieving success in commercial, environmental, and social aspect in the first phase development, the future of PoKT can be truly secured. However, at the time when this study was conducted, the first phase development of PoKT is environmentally and socially feasible but not commercially. The main reason is due to a negative business case as a result of expensive capital expenditures coupled with insufficient income projection. The main component of the capital expenditure is the non-commercial basic infrastructures especially the breakwater.

- Correct location of breakwater:

The breakwaters are essential infrastructure designed to provide a sheltered port basin to assist ship-to-shore cargo handling activity. Container and breakbulk vessels are the main driver for installing the breakwater due to their minimum heaving motion tolerance when off/onloading their cargo, compared to liquid and dry bulk vessels. Currently, the first phase development of PoKT would include construction of a breakwater in its list of basic infrastructure. The location of the first breakwater is determined by considering the presence of existing industries, jetties, Bah Bolon River mouth, and the already bought land location. Optimization on the exact coordinate and layout of the breakwater could still be conducted through coastal and river sediment transport modelling combined with vessel traffic simulations, which is out of scope of this study. The interest to the first breakwater specific to this study is in providing answers to these questions.

- Do construction of a breakwater really needed in the first phase?

**No**, Because according to market study conducted by PoRA most of PoKT commercial potential located in Dry Bulk and Liquid Bulk cargo segment. The breakwater is only required if the JV do decide to build either container terminal or breakbulk terminal to fulfil other non commercial nor technical driven ambitions.

- Can the breakwater construction be postponed to make the business case of the first phase more positive?

**Yes**, as long as the container cargo segment being handled in the existing Multi Purpose Terminal (MPT) located in North west of PoKT JV location. Currently this MPT is being operated solely by Pelindo 1. If the MPT is assumed to be part of the JV in the future, there would be no issue in temporarily place the container cargo handling in the MPT. Construction of a jetty for either dry bulk terminal or liquid bulk terminal should be prioritized instead of for container or breakbulk cargo, since they (liquid and dry bulk terminal) do not which does not required sheltered port basin. The trestle layout should follow the later breakwater layout so that in the future the breakwater could be constructed jointly with the trestle by using a modular type structure. The preliminary idea to apply such a modular concept is to first build a deck on pile trestle which would later be combined with trapezoidal caisson type breakwater (Takahashi, 2002). Further study would need to be conducted to confirm this preliminary idea. However, it should be known that even if the modular concept would later be proved not viable, the breakwater may simply be constructed on the east side of the trestle. Thereby, saving breakwater materials for a lower cost.

- Incorrect determination of type of Industrial clusters:

The first clients of PoKT would strongly influence the direction on which PoKT would embark. Currently there is an aluminium smelter, palm oil and rubber industry, and gas field located within reachable distance. These industries could be categorized into alloy, bio-based, and petrochemical industry by judging their product feedstock and usage. Even though with numerous market study considering each industry category potential, no one knows for sure what type of industry would become the JV first clients. Due to financial and availability of land, only one type of industry in the first phase development can be accommodated. The industrial type of the first clients would also determine the type of terminal which would be constructed in the first phase development of the Port. Alloys industry would require dry bulk terminal, petrochemical would require liquid bulk terminal, while bio-base might require both.

- Resilience port, independent from global economic and political situation:

In order to become a resilience port, the role of first clients in PoKT is crucial. They need to provide stable cargo flow to ensure PoKT vessel traffic. One solution to achieve this, is to produce a relatively irreplaceable cargo (i.e: steel, fertilizers, aromatics chain petrochemical product) which is demanded by the domestic market each industry suppose have a relatively irreplaceable value towards the market. By doing so, PoKT would have a unique competitive edge against its competitors in Malaysia and Singapore

### 3.4.3 Adaptive Masterplan

An adaptive port masterplan layout has been designed based on PoRA original port masterplan, and explanations in sub section 3.4.1 and 3.4.2. This layout adopts a sectoral approach in its usage, where the PoKT designated area are divided into nine sectors. The size and number of sectors can be revised when the masterplan is renewed in every five years. The number of the sector reflects the sequence in which the PoKT should be developed until its final development. In principle, the development of the PoKT should be directed westward and along the coast of the 1<sup>st</sup> phase development as long as possible, to save cost before redirecting the river. Once, an optimal development to the west part has been achieved, the development might be directed to the east part with first redirecting the Bah Balon river.

However, this principle only serve as recommendation and can be altered if there is a justified reason. For example if, the Indonesian government sees the development of the container and breakbulk terminal as a priority, then a development towards the east side of 1<sup>st</sup> phase development can not be avoided. Nonetheless, if this direction of development has been selected, the JV and other shareholders must be prepared with significant additional cost for the PoKT next phase development.

Based on this layout, three possible future realization of PoKT could be achieved. The main difference between each realization, is the location and the proportion of each industrial cluster compared to the total size of the port. The factor that would significantly affect which realization the PoKT would develop into, is the type of th 1<sup>st</sup> industrial tenant. Because, the type of the 1<sup>st</sup> industrial tenant would determine the type of port facilities which will be developed in the 1<sup>st</sup> phase. The PoKT authority would therefore prefers the same type of industrial tenants for the next development to enable shared facilities usage. The sketch of the adaptive masterplan template and three possible realization of PoKT are expressed in the next pages.

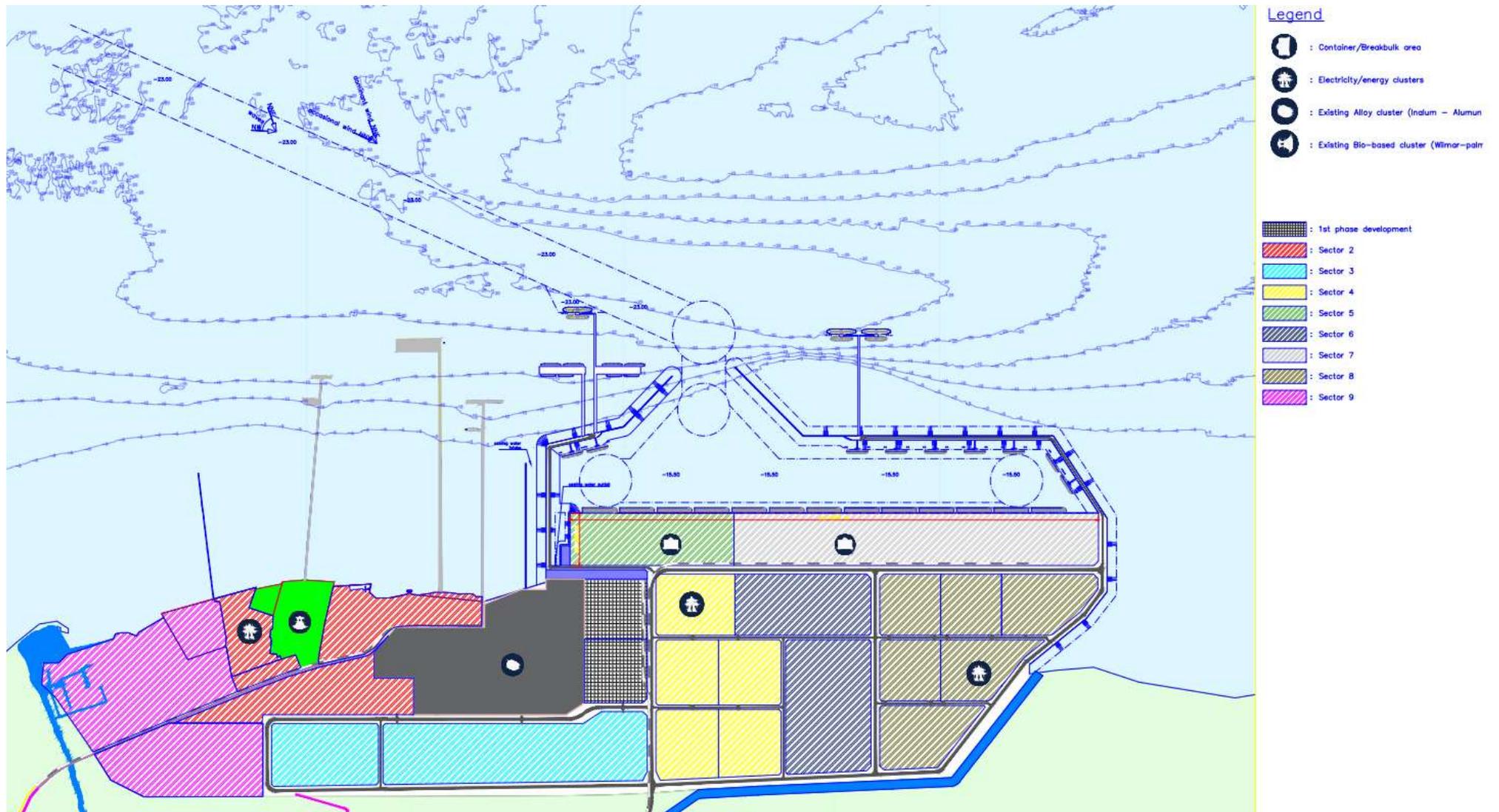
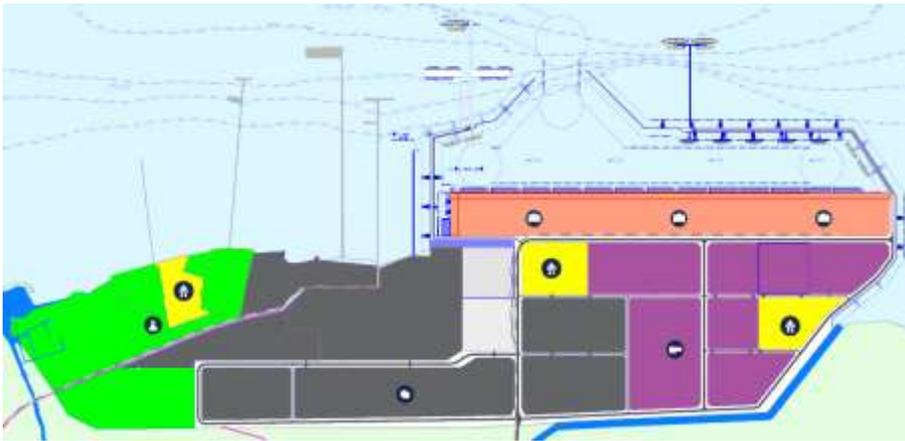
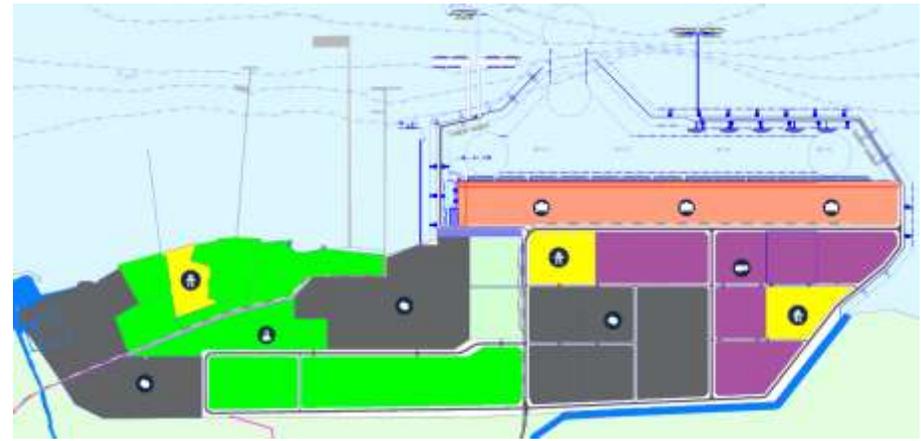


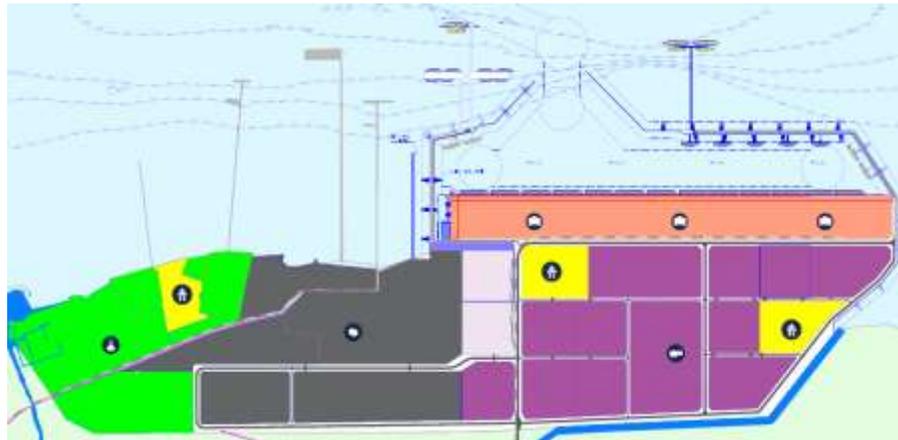
Figure 18 PoKT Adaptive Masterplan template and three possible future realization (Source: Author)



(First client alloy industry)



(first client bio-based industry)



(First client petrochemical industry)

Figure 19 PoKT three possible future realization (Source: Author)

## 4 1<sup>st</sup> phase layout

This chapter would discuss the design process of the PoKT first phase layout. All explanations and narratives from the previous chapter would be taken into account. Brief explanation on the governing assumptions that are used in the planning of the PoKT first phase layout would also be contained in this chapter. The assumptions and parameters that are written in this chapter is compiled from Royal Haskoning DHV (2014) report, various PoRA expert's work and interviews with the PoRA experts.

### 4.1 Basic assumptions

#### 4.1.1 Environmental conditions

##### Metoccean conditions

- Wind and Waves (Hindcasting)
  - Predominant wave north east (NE)
  - Significant wave height ( $H_{1/3}$ ) = 0.51 m
  - Maximum wave height ( $H_{1/100}$ ) = 1.27 m
  - Wave height probability  $H > 0.5$  m = 3%, Calm = 74.5%
  - Significant wind speed 11 Knot
- Current and Tide
  - Tide category mixed semidiurnal with range of 3.6 m
  - Max. current during spring tide 1.3 m/s
  - Max. current during neap tide 0.7m/s

##### Soil conditions

- Seabed and coastal soil sediment is sandy silt (relatively weak for foundation)
- Located in an earthquake prone area
- The first phase development will be built on ± 85 hectare land, outside existing industrial facilities (±500 hectare)

#### 4.1.2 Cargo forecast

According to the PoRA team analysis, in the Sociable Oasis<sup>4</sup> scenario PoKT projected to have up to 180 Million Metric Tonnes (MMT)/year of cargo throughput in the next 30 years. For comparison, the existing Multi Purpose Terminal have the capacity 10 MMT/year, Port of Belawan maximum capacity is 35 MMT/year, and the productivity of PoRA in 2016 is around 461.2 MMT/year. In the Sociable Oasis scenario, the PoRA team assumes several parameters for the PoKT as follows:

- Integrated port industrial complex driven by various industrial clusters (metal, petrochemical, refineries, etc.)
- 6% GDP growth
- Compound annual growth rates<sup>5</sup> for 30 years
  - Liquid bulk 14%
  - Dry bulk 15%
  - Break bulk 11%
  - Containers 18%

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<sup>4</sup> Please refer to page 31 for further information regarding the scenarios

<sup>5</sup> Assumed "smoothed annualized gain" of investment over a given time period (Wayman, 2015)

- Growth were first initiated by cargo flow related to industrial clusters (as product or feedstock). Container terminals starts to be developed when the port reached relatively stable cargo throughput and quite healthy financial portofolio (around 10 years from now).
- The forecast constructed using combination of Top-Down and Bottom-up approach through desk research and interviews with relevant industry representative.

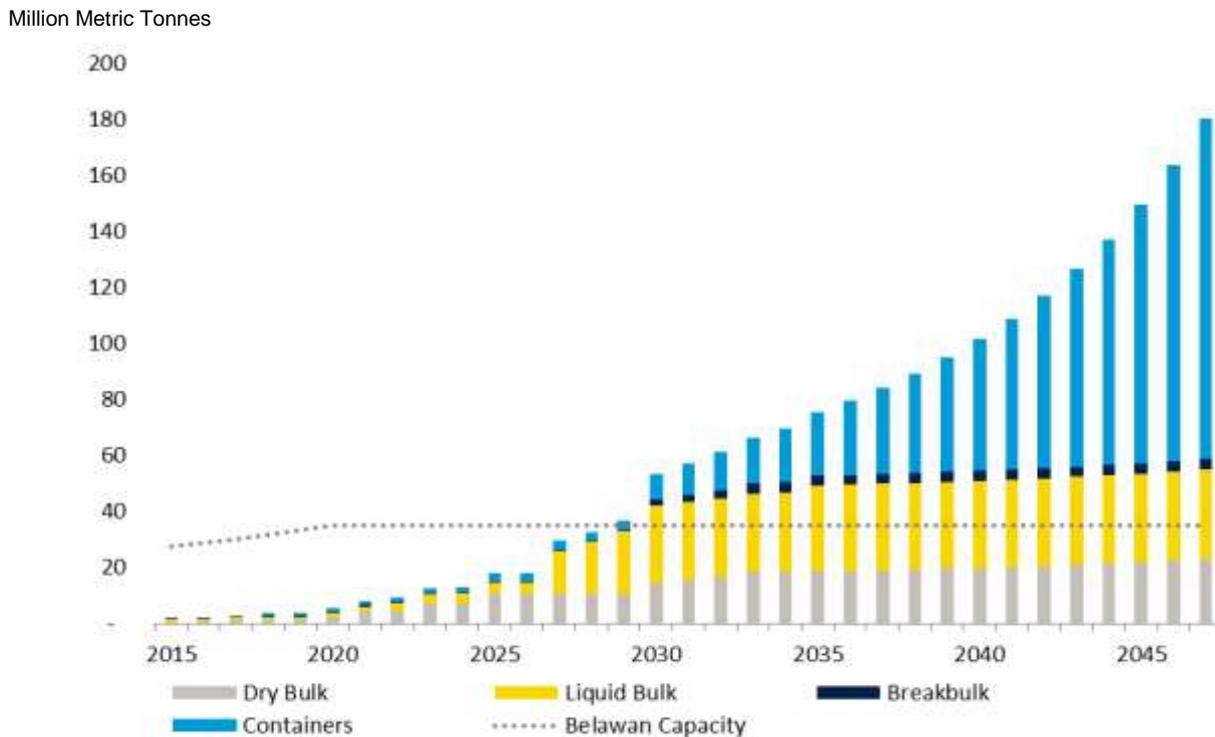


Figure 20 Port of Kuala Tanjung cargo forecast in Port of Rotterdam Industrial max case (Source: KTPO, 2017)

### 4.1.3 Required facilities

The cargo forecast were used as the main driver in determining required facilities. In determining which facilities should be developed in the first phase layout, PoRA applied a “no-regret” decision making. No- regret implies that all facilities that are being build in PoKT first phase development should be always usefull in most plausible scenario. Combination of these facilities should also resulted in a positive business case which implies that the first phase development should be commercially feasible independent of the other stages of developments. The minimum required facilities for the port to function and be profitable are as follow:

- Cargo handling terminal (either dry/liquid/breakbulk or container)
- Utilities (water, electricities, communication facilities, and others)
- Pioneer Industrial client (represented by “Industry A” in Figure 21)
- Main corridor (either roads, railways, pipelines, or inland waterways)

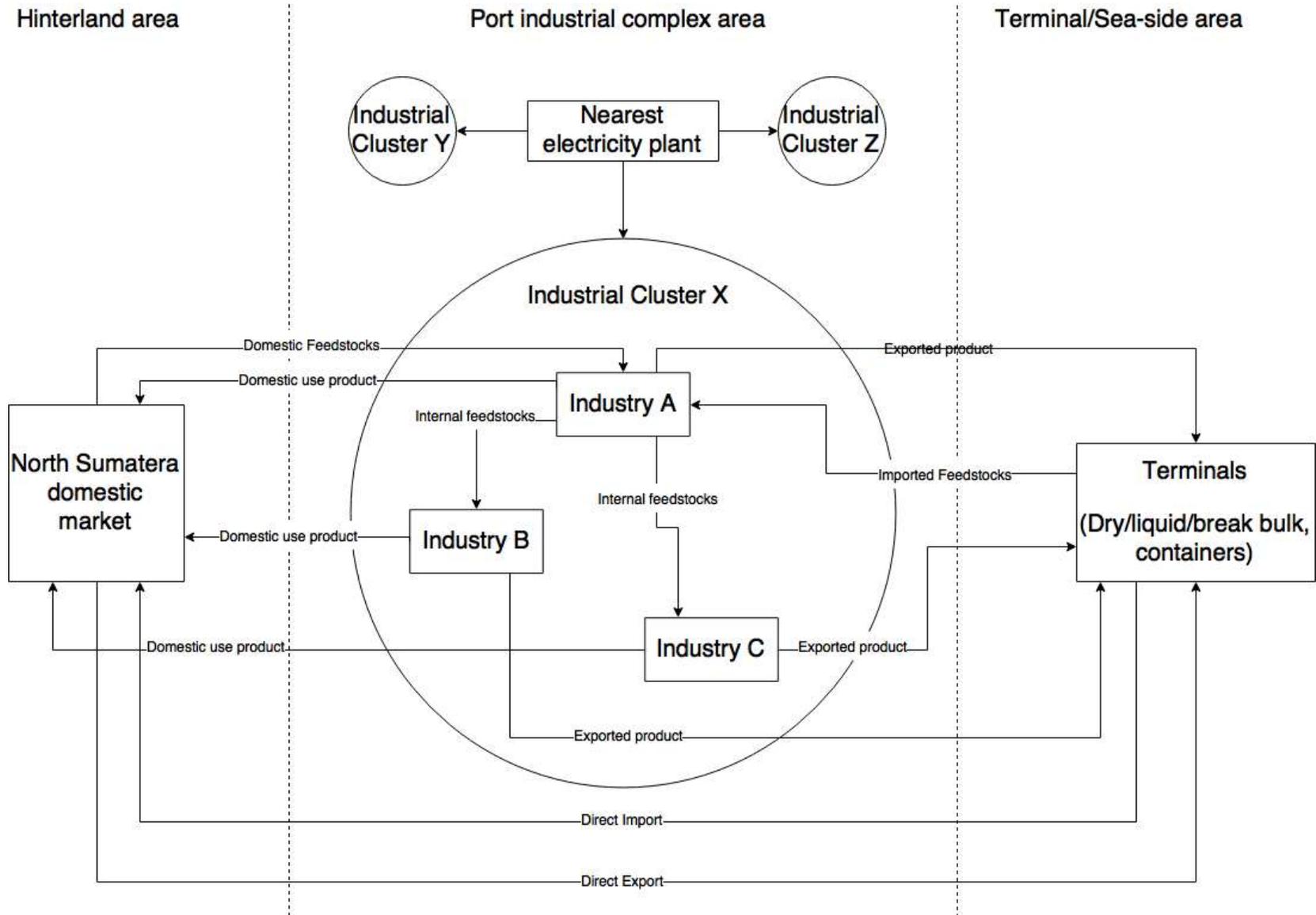


Figure 21 Port of Kuala Tanjung port industrial complex with accounting circular economy model (Source: Author)

As can be seen in Figure 21, a correct choice in determining pioneer industry (“Industry A”) would attract additional industry in PoKT in the future. A profitable and sustainable industrial cluster environment would then provide less volatile cargo flow to PoKT terminals. Therefore in planning PoKT, designing only the cargo handling terminals is not enough, without properly selecting the first pioneer industry which suites with the Port masterplan. List of driving forces in determining facilities and infrastructures for the first phase development of PoKT presented in the table below. These driving forces were identified through combined efforts of interviews with the PoRA experts and literature review. It should be noted that the driving forces could mean a positive support for realizing the infrastructure or a negative remark to not build the infrastructure. The positive support are indicated with blue colored text while the negative remark are by red colored text.

*Table 11 Driving forces and its implications to the Port first phase layout facilities*

Major driving forces	Facilities or infrastructures
<ul style="list-style-type: none"> <li>- Provide separation between cooling water intake and hot water out take for the electricity plant to prevent re-circulation</li> <li>- Provide sheltered area for container and breakbulk vessels</li> <li>- Expensive structure, currently spent ± 40% of the total CAPEX, excluding land acquisition costs</li> <li>- Most cargo potential of Kuala Tanjung is in dry and liquid bulk cargo, and Breakwater is not needed for these type of terminals</li> </ul>	Breakwater
<ul style="list-style-type: none"> <li>- Costly land acquisition process (in terms of time and price)</li> <li>- Lots of inhabitant living inside the project boundary</li> <li>- Possible government support in providing land, which if it does realized would significantly provide positive effect for the project</li> </ul>	Availability of land (± 85 hectare)
<ul style="list-style-type: none"> <li>- All type of industry which would reside in Port of Kuala Tanjung require electricity source to be functional</li> <li>- Existing electricity supply 180 MW supplied by PLTA Asahan deemed far from sufficient for expansion of existing industries and for industries in Port of Kuala Tanjung</li> </ul>	Electricity plant
<ul style="list-style-type: none"> <li>- Cheap and availability of reliable coal supply</li> <li>-State-of-the-art technologies are considered environmentally friendly</li> <li>- Possibly negative public image</li> </ul>	Coal fired electricity plant

Major driving forces	Facilities or infrastructures
<ul style="list-style-type: none"> <li>- State owned cement industry shows interest in building new factory in Port of Kuala Tanjung</li> <li>- Alumina produced in existing aluminium smelter is a feedstock in producing cement</li> <li>- Relatively stable demand of cement in developing countries (hard to replace construction material)</li> <li>- Does not become a feedstock for other industrial activity</li> </ul>	Cement plant
<ul style="list-style-type: none"> <li>- There is already a Multi Purpose Terminal with capacity of 400,000 TEU/year exist nearby</li> <li>- Huge additional capital investment required (breakwater, capital and maintenance dredging)</li> <li>- Risk of direct competition with Klang and Singapore</li> </ul>	Container and Breakbulk terminal
<ul style="list-style-type: none"> <li>- Highest cargo throughput potential based of Port of Rotterdam Authority forecast</li> <li>- Cargo commodities relatively irreplaceable in their usage (i.e: Iron ore, coal, grain, and alumina)</li> <li>- Relatively more complex and expensive equipment required compared to liquid bulk terminal</li> <li>- Slightly more depth required compared to liquid bulk terminal</li> </ul>	Drybulk terminal
<ul style="list-style-type: none"> <li>- Cheaper and less complex facilities than dry bulk terminal</li> <li>- High wave tolerance and require less depth compared to dry bulk terminal</li> <li>- Strongly dependent on petrochemical cargo traffic</li> </ul>	Liquid bulk terminal
<ul style="list-style-type: none"> <li>- Wide variety of feedstock (i.e: steel scrap, household waste, industrial scrap)</li> <li>- Produce wide variety of ferro-alloy product such as steel that could be used as feedstock for other alloy industry</li> <li>- Require less land compared to conventional steel plant</li> <li>- Low production capacity compared to conventional steel plant</li> </ul>	Recycling alloy plant

Major driving forces	Facilities or infrastructures
<ul style="list-style-type: none"> <li>- Aromatics chain are relatively harder to be replaced by bio-based chemical compared to other petrochemical chains (i.e: olefins)</li> <li>- Less variety of usage compared to olefins</li> </ul>	Aromatics plant
<ul style="list-style-type: none"> <li>- Wide variety of downstream products (i.e: food industry, pharmaceutical, cosmetics, household products)</li> <li>- Relatively easy to find feed stock (i.e: corn, wheat starch, and palm oil)</li> <li>- Expensive production cost compared to conventional ethanol plant</li> </ul>	Bio Etanol plant
<ul style="list-style-type: none"> <li>- Existence of Bah Bolon river which bring more sediment to the port basin</li> <li>- Provide more land to be developed inside project boundary</li> <li>- Serve as physical boundary for the Port</li> <li>- Only relevant if dredging near the river mouth conducted for sheltered port basin area</li> </ul>	River diversion

#### 4.1.4 Alternative layouts

Based on list of required facilities provided in the previous sub section, alternative first phase layouts for PoKT has been developed. Through interviews with the PoRA experts during the study, the relative certainty of each facilities to be constructed in the first phase has also been identified as follows:

*Table 12 Relative certainty of Port of Kuala Tanjung first phase facilities*

Relatively certain facilities	Relatively uncertain facilities
<ul style="list-style-type: none"> <li>• Dry bulk terminal</li> </ul>	<ul style="list-style-type: none"> <li>• Breakwater</li> </ul>
<ul style="list-style-type: none"> <li>• Liquid bulk terminal</li> </ul>	<ul style="list-style-type: none"> <li>• River diversion</li> </ul>
<ul style="list-style-type: none"> <li>• Electricity plant</li> </ul>	<ul style="list-style-type: none"> <li>• Container and breakbulk terminal</li> </ul>
<ul style="list-style-type: none"> <li>• Cement plant</li> </ul>	<ul style="list-style-type: none"> <li>• Ship breaking yard</li> </ul>
<ul style="list-style-type: none"> <li>• Recycling plant</li> </ul>	
<ul style="list-style-type: none"> <li>• Aromatics plant</li> </ul>	
<ul style="list-style-type: none"> <li>• Bio-ethanol plant</li> </ul>	
<ul style="list-style-type: none"> <li>• Available land size <math>\pm</math> 85 hectar</li> </ul>	

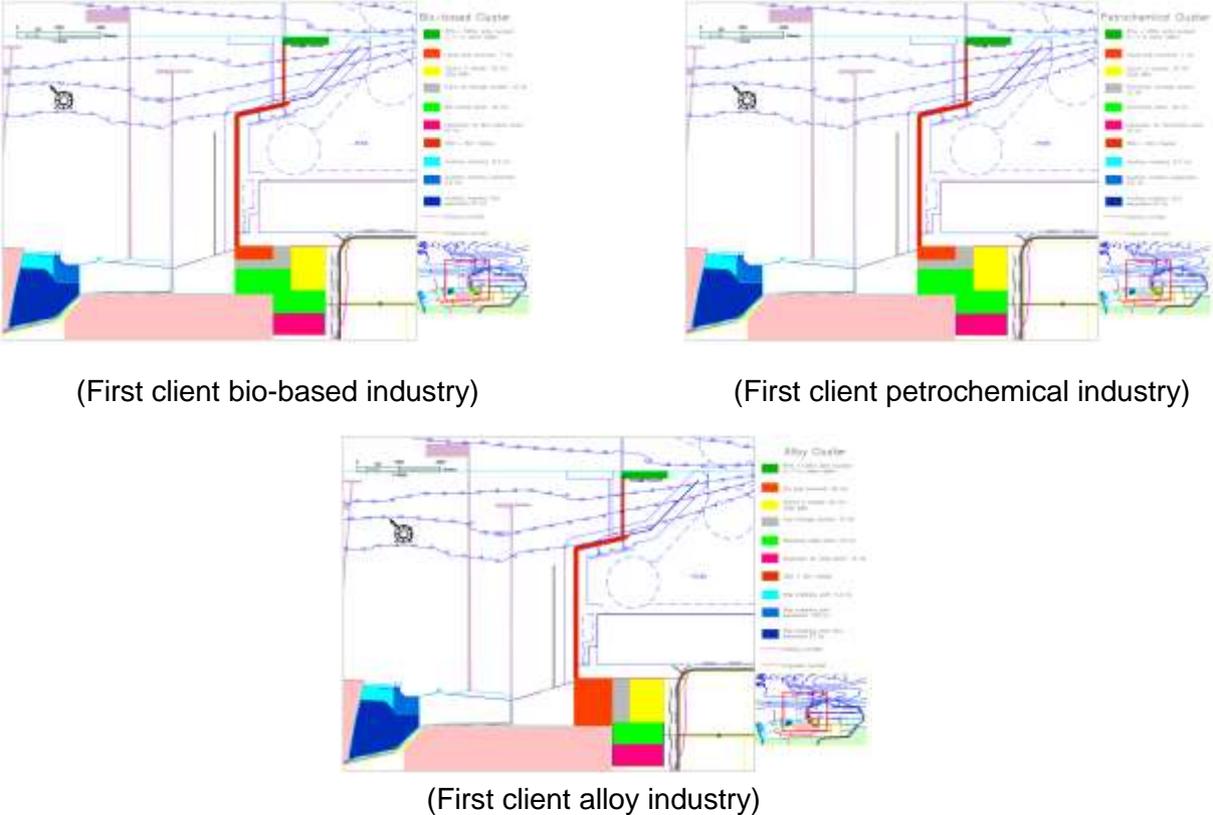
The distinct difference between the two type of facilities above is the relative certain facilities are infrastructures that are essential for the first phase of PoKT to operate and be profitable. On the other hand, the relatively uncertain facilities are infrastructure that is important for the whole masterplan but not urgent to be developed in the first phase (postponable). It is important to note here that although "Available land size" categorized as relatively certain (since it is essential to have a land for the construction to begin), in practice there is still

considerable amount of uncertainty regarding the actual land size that is available to be developed. Negotiations and efforts are still on-going by the time this report was written. Therefore the ± 85 hectare land size assumption that are being used here, is still likely a subject to change. Next, by considering the classification of industrial clusters<sup>6</sup> and the type of terminal required to serve the industrial clusters, the type of facilities to be constructed in the alternative layouts are determined as follows:

*Table 13 Type of facilities to be constructed in the Port of Kuala Tanjung first phase*

Alloy cluster	Bio-based cluster	Petrochemical cluster
Land size ± 85 hectar	Land size ± 85 hectar	Land size ± 85 hectar
Dry bulk terminal	Liquid bulk terminal	Liquid bulk terminal
Electricity plant	Electricity plant	Electricity plant
Cement or recycling steel plant	Aromatics plant	Bio-ethanol plant
Ship breaking yard		

The breakwater, river diversion, and container and breakbulk terminals have been excluded to reduce the CAPEX required for the first phase development to be developed. On the other hand a ship breaking yard has been included in the list because it does not require extensive amount of investment from the JV corporation other than additional land required that is located outside of the future sheltered port basin area.



*Figure 22 Alternatives of Port of Kuala Tanjung first phase layout<sup>7</sup>. (Source: Author)*

<sup>6</sup> Industrial clusters are classified as: Alloy, Bio-based, and Petrochemical cluster. For more information, please go to page 63  
<sup>7</sup> For better image quality, please visit Appendix B

## 4.2 Increasing the robustness of each alternative layouts

Next, an analysis of each cluster’s unique properties have been conducted. Since all item listed in Table 14 are all relatively certain, the use of the seizing, mitigating, hedging, and shaping (SMHS) actions would be slightly different than in sub section 3.4.2. A SWOT analysis is conducted to first extract potential vulnerabilities/opportunities of each cluster. Then the SMHS actions were used to increase the flexibility and robutstness of each cluster alternatives.

Table 14 Increasing the flexibility and robustness of each clusters<sup>9</sup>

	Alloy	Bio-based	Petrochemical
Strength	<p>Relatively hard to replace cargo commodities (i.e: steel and aluminium)</p> <p>SH: Start by building the most versatile alloy factory (no-regret decision)<sup>10</sup></p>	<p>Cheap and relatively abundant feedstocks (i.e: corn, grains, food waste)</p> <p>SH: Most cargo requires liquid bulk terminal, which have some common properties with <b>petrochemical</b> cluster</p> <p>SH: - make sure common facilities are safe to use and not damaging other type of cargo - Make the liquid bulk terminal in such away that it is possible to add more hoes or pipelines to separate between <b>consumable</b> goods with other chemical products</p>	<p>Cost-effective production process with large variety of downstream products</p> <p>SH: Most cargo requires liquid bulk terminal, which have some common properties with <b>bio-based</b> cluster</p> <p>SH: - make sure common facilities are safe to use and not damaging other type of cargo - Make the liquid bulk terminal in such away that it is possible to add more hoes or pipelines to separate between <b>toxic</b> goods with other chemical products</p>
Weakness	<p>Cargo handling facilities are not interchangeable with other clusters</p> <p>M: Invest in single point mooring or other fast yet cost-effective cargo handling facilities for liquidbulk</p>	<p>Expensive production process makes bio-based chemical plants commercially not attractive</p> <p>M: Government subsidy or tax relief might attract pioneering industry to Kuala Tanjung</p>	<p>Dependent on reliable supply of oil and gas</p> <p>M: List number of alternative supplier, or develop refineries in the port (which currently is highly unlikely)</p>

<sup>9</sup> Seizing (SZ), Mitigation (M), Hedging, and Shaping (SH) actions

<sup>10</sup> No- regret implies that all facilities that are being build in Port of Kuala Tanjung first phase development should be always usefull in most plausible scenario, see Page 66

	Alloy	Bio-based	Petrochemical
Opportunity	<p>Developing Indonesia market would require substantial amount of alloy products to satisfy its infrastructure construction demand</p> <p>SZ: Coordinate industrial factories with Indonesian shipping lines and other Indonesian ports in “Tol Laut” network to ensure optimum domestic consumption</p>	<p>Global sentiment (policies and social developments) are in favour of bio-based products</p> <p>SZ: Attract world leading bio-based chemical industry to partner with state owned companies under with central government coordination</p>	<p>Existence of state operated gas field nearby that have shown interest in installing pipeline from regasification site to Port of Kuala Tanjung</p> <p>SZ: Ensure the construction of the pipeline to port of Kuala Tanjung. Attract fertilizer of other companies that use natural gas as feedstock to build plants in the port</p>
Threat	<p>Currently there is global oversupply of steel combined with the already highly competitive price of Chinese produced steel</p> <p>H: Focus on fulfilling domestic demand, coordinate with national government to establish strategic trade policies to protect cargo flow</p>	<p>Potentially increase erosion rate and carbon footprint in plantation area, which common in homogenous plantation fields (i.e: vast corn fields)</p> <p>H: Advise North Sumatera government to establish policies and education effort to society regarding this issues,</p>	<p>More and more downstream products are able to be replaced by bio-based chemicals Each year</p> <p>H: Do not use petrochemicals as the main business model in the industrial port. Invest in more hardly replacible chemical or in further optimizing production process to make it more competitive.</p>

## 5 Evaluation of the alternatives

### 5.1 Introduction

In this chapter the three 1<sup>st</sup> phase layouts that have been developed in the previous chapter would be evaluated. The evaluation would be based on the financial aspect and the added values that each layout could bring to North Sumatera province.

### 5.2 Business case

#### 5.2.1 Discounted Cash Flow

In evaluating the financial aspects of PoKT, a business case calculation which is based on Discounted Cash Flow (DCF) method would be used. DCF method was chosen since it is widely accepted banks to evaluate attractiveness of investment opportunities (Demenint, 2016). This method calculates the Total Net Present Value (NPV) of the investment opportunity for the given time frame by taking into account future cash flows and discount rate. The DCF formula is presented as follows:

$$NPV = \sum_{i=1}^n \frac{FCF}{(1 + WACC)^i}$$

Where,

FCF = Future Cash Flow

WACC = Weighted Average Cost of Capital

i = Time interval between year (1 year)

n = Observed period (35 year)

The future cash flow is simply the sum of income and expenses that PoKT experienced in the respective year. WACC is the representation of various financial costs and risks variables, such as Cost of debt and Risk free rate summarized into a single figure. These variables are highly dynamic and depends on a project financial and risk portfolio. Throughout the project, WACC figure will constantly be updated, following the status of the project. In the end, the final WACC figure will be determined by the bank that provides funding for the project. Therefore, an extensive calculation conducted by a corporate financial expert would be needed to produce a WACC figure close to the bank estimation. At the moment, the WACC was estimated to be 15.4% by the PoRA corporate financial expert. As a comparison, the WACC figure for construction project in Indonesia calculated by an independent French consulting company is 15.56% at 9 September 2017 (waccexpert, 2017). For more detailed WACC calculation based on PoRA analysis please refer to Appendix D.

### 5.2.2 Port of Kuala Tanjung Business Case

Table 15 Port of Kuala Tanjung Business Case 2018-2040 in Million USD

	Alloy Cluster	Bio-based Cluster	Petrochemical Cluster
WACC (%)	15.4 %		
IRR (%)	-5.35%	-7.57%	-7.74%
CAPEX	-112.63	-112.63	-112.63
OPEX	-21.38	-21.28	-21.27
Income	28.06	24.26	23.642
NPV	-105.95	-109.66	-110.26

The result of the PoKT business case calculation is summarized in the Table 15 above. Detailed calculation of the PoKT business case, can be found in Appendix D. Internal rate of return (IRR) is a required discount rate to make the NPV of the project zero. Higher IRR means the project has the capability to pay back its initial investment and start become profitable faster than the lower IRR. In the case of PoKT, all layout alternative have a negative IRR because all cluster alternative also have negative NPV. A Negative IRR means even the sum of the project income when it starts operational would never be able to payback the sum of its expenses (CAPEX and OPEX). Therefore, efforts needs to be done to improve the project financial feasibility before actually start building the port. List of possible actions to improve port of kuala tanjung business case and its implication listed in table 16.

Capital expenditure (CAPEX) is total cost of the infrastructures required to build in the 1<sup>st</sup> phase development. The infrastructure that are being taken into component of the CAPEX calculation above are as follows:

- Trestle
- Jetty
- Road
- Drainage

All cost related to land acquisition and improvement are excluded, since it is assumed to be provided by Indonesian government. Other cost such as utilities and client related structure are also excluded. As observed in the table above, the CAPEX for all type of cluster is the same. This is due to the same layout of sea-side facilities for all layouts. Because of the time and data constraint, a benchmark approach was used to calculate the CAPEX above. The Indonesian ministry of transport planning guide benchmark, PM 75 year 2013 has been selected as the main reference. For comparison, a check for the jetty structure benchmark has been conducted with other available benchmark as follows:

- PM 75 year 2013 benchmark: ~948.15 USD/m<sup>2</sup> (Selected)
- Royal HaskoningDHV basic design: ~1560 USD/m<sup>2</sup> (Upper bound)
- Ministry of transport basic design (KP 148 year 2016): ~150 USD/m<sup>2</sup> (Lower bound)

It can be seen that the benchmark varies greatly depending on the jetty layout and depth. It should noted that benchmark calculations mightly lead easily towards over/under estimation if not used cautiously. Therefore, further analysis on PoKT CAPEX on basic design level is recommended for better accuracy. Currently the calculation is estimated to be accurate with a margin of +/- 30%.

Operational expenditures (OPEX) are the cost of operating the port. The calculation on OPEX was conducted using the in-house benchmark of PoRA. The cost component of PoKT OPEX in the business case calculation along with its dependence are as follows:

- Organization cost as a function of port size and inflation rate
- Insurance cost as a function of CAPEX
- Concession fee for port activities as a function of port related income
- Maintenance cost as a function of CAPEX

The “Income” represents total gross of income that PoKT might receive until 2040. Since PoKT adopts land-lord port model, its source of income mainly divided into port dues (berthage and wharfage) and land lease fee. The difference between the cluster income mainly comes due to different cargo throughput forecast for each type of cluster. Alloy cluster has the highest income since the feedstock required for cement plant forecasted to generate higher throughput than the other type of cluster. Cement plant feedstock would also generate higher throughput compared to steel plant. Therefore from purely commercial perspective, it would be more beneficial to invest in cement plant. Whereas if the JV has decided to invest in cement plant, the construction of ship breaking yard should be postponed, as it requires the steel plant to be achieve its full potential.

*Table 16 Port of Kuala Tanjung Business case sensitivity in Million USD*

Action	Impact	Alloy Cluster		Bio-based Cluster		Petrochemical Cluster	
		New NPV	Δ NPV	New NPV	Δ NPV	New NPV	Δ NPV
States guarantees project investment	WACC: 15.4 % > 11.6 %	-104.538	+1.41	-109.634	+0.03	-110.25	+0.01
Design optimization	Lower CAPEX by ~ 20%	-83.425	+21.11	-87.13	+22.53	-87.74	+22.53
Higher tariff	Increased income <sup>11</sup>	-97.26	+7.27	-103.47	+6.1	-104.471	+5.8
All sensitivities combined		-70.16	+34.38	-78.71	+30.95	-81.94	+28.32

It is clearly depicted in the table 17, even in the best possible business case scenario, the 1<sup>st</sup> phase development of PoKT would still have a negative NPV. Therefore, it is concluded that PoKT would require an external finance support. Since this project is listed under Indonesia’s national strategic project, it is logical to assume that the external finance support would be provided by the Indonesian government. It is important to reinstate here that all calculation done in this chapter is under the assumption that Indonesian government would conduct the land acquisition process and gave the JV concession agreement to exploit the land. Therefore the form of government support that is expected should be other than providing the land. However, the analysis on the alternative type of government financing support for the project is out of scope of this research. As a brainstorm material, the financing support might come of (OECD, 2015):

<sup>11</sup> Ranging from 20 – 100% depending on the type of the tariff. The rate of the tariff is confidential

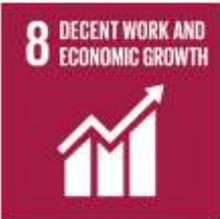
- **Availability payments:** The government pays for the construction of some infrastructure in the project. Often the non-commercial expensive infrastructure (i.e: jetties or breakwaters) would be the object of the payment. In the case of PoKT, government could pay for either the construction of the trestle or jetty since they are the major cost component in the CAPEX.
- **Offtake contracts:** The government made an agreement with PoKT authority to ensure their minimum revenue. This agreement would result in a more stable revenue stream in the port which therefore reduce future uncertainties. For instance, the PoKT revenue plummeted due to lower cargo throughput than pessimistic cargo forecast for whatever reason. Then the government would have give incentive for PoKT to ease the port financial burden.
- **Provision of Capital:** The government would buy a portion of PoKT share to increase its capital.
- **Grants and taxation:** Grants is a type of financial support which could come in a form of fund injection when the construction is still on progress, or when the port is already operational. The injection could be given “free of charge” or “under certain condition”. On the other hand, taxation means the government would provide support in form of tax policy modification. Taxation may come in form of reduce or suspend taxes, or extended tax break. Taxation usually is included in grants because it is a form of fiscal transfer by either enhancing the project revenue directly or reduce its expenses.

### 5.2.3 Added values

The amount of generated social and economic added values by a project is often used as justification for a government support (Molino & Zuleeg, 2011). To analyse the social and economic added values which a project could bring to its surrounding region, an analysis based on backward and forward linkages is required (Hefner & Guimaraes, 1991). Backward linkages are economic activity that are induced due to the relationship between interdependent companies (i.e: Supplier and manufacturer). Forward linkages are economic activity that are induced by the relationship between a company and its customer. On the other hand, environmental added value is more complex to be calculated. Because it has broad field of interest such as impact on wild life, ecosystem balance, chemical pollution, etc. As one of the widely accepted method to calculate the environmental added value, is to represent it in a form called “Sustainable value” (Figge and Hahn, 2004).The sustainable value directly scores the sustainability aspect of a project. To calculate this value, the same concept in calculating opportunity cost in financial economics has been used. Opportunity cost is the total possible income which might have been received if other alternatives has been chosen.

To conduct either the backward and forward linkage or sustainable value analysis, extensive amount of data and time is required. Due to time and resource constraint, analysis on the PoKT added values has been conducted by using a qualitative assessment, except for the job creation category. The calculation on the direct job created by PoKT, have been conducted by a consultant (Rebel consultant, 2017). While for indirect employment, the employment multiplier is used to estimated the derivative jobs created as an effect of the direct employment (contentfirst, 2008). To categorize the added value that PoKT could bring to North Sumatera province, the UN-SDG has been used as a reference. The selection of which goal of UN-SDG is relevant to the PoKT is conducted by the author’s qualitative assessment. The description on the added values in this sub-section should only be used as a reference in high level discussions and not a tool for decision making. Further analysis using the backward and forward linkages as well as the sustainable value is required for more detailed and reliable result.

Table 17 Added value analysis of Port of Kuala Tanjung

Added values categories based on UN-SDG	Type of cluster	Analysis
	Alloy	Alloy industries such as steel/cement plants would generate the highest amount of direct jobs due to their labour extensive factories. However since their downstream product is not as varied as bio-based and petrochemical industry, their employment multiplier considered to be the lowest within the three alternatives. As a net result quite high GDP growth in the region could be achieved
	Bio-base	Bio-based industries such as Bio-etalol plants would generate relatively similar amount of direct jobs with petrochemical factories due to their similar production process. Since nowadays, most of these factories production method have been automated, they would generate less direct job compared to Alloy industries. The amount of indirect jobs generated by the bio-based company however, would be less then the petrochemicals. Because not all petrochemical products could be replaced by the bio-based industry. As a net result moderate to high GDP growth in the region could be achieved
	Petrochemical	As mentioned before the Petrochemical industries such as Aromatics plants would generate relatively similar amount of direct jobs with Bio-based factories. Since this industry have the most vast range of downstream products, it would generate the highest amount of indirect jobs, reflected by its highest employment multiplier. As a net result possibly the highest GDP growth in the region could be achieved
	Alloy	By introducing the integration between ship breaking yard and the steel recycling plant, PoKT would surely become one of the most innovative Port industrial complex in the world. Moreover, due to their molecular structure, most alloy industry products have relatively irreplaceable function as materials for infrastructure
	Bio-base	Bio-based industries requires extensive research and development in order to optimize their production process up to the level of petrochemical industries to remain competitive. Therefore, highest level of innovation is to be expected by the existence of this cluster. However, since this industry is still relatively new compared to alloy and petrochemical industry, the level of industry activity estimated to be not as high as the other two.

Added values categories based on UN-SDG	Type of cluster	Analysis
	Petrochemical	<p>Due to its vast range of downstream product, petrochemical would generate the highest level industrial activity in the region. Although, since there is no plan in building refineries in PoKT any time soon, the potential of the petrochemical cluster would be considerably limited. In the current plan, amount of innovations induced by the petrochemical cluster considered relatively low, since there is no new strategies discovered yet.</p>
	Alloy	<p>In its self, alloy industry would introduce decent amount of pollution in the surrounding region, which could be considered relatively harmless. However, with the addition of ship breaking yard facility, environmental hazard in the surrounding region would be increased. Strict regulation on metal waste and related chemical agents is required to avoid environmental damage in the future.</p>
	Bio-base	<p>Bio-based industry could possibly be the most sustainable cluster option in PoKT due to its lowest carbon footprint. Nonetheless, this industry would attract farmers in region to only cultivate plantations that could be sold to the bio-based plants. This behaviour would lead towards a homogeny plantations that would have negative impact in the regions such as increased rate of erosion in the soil. Therefore the government should act proactively the prevent such situation.</p>
	Petrochemical	<p>Petrochemical industries has the highest risk for environmental pollution due to the nature of their product. Even though, with the latest manufacturing technology and safety policy the risk has been considerably reduced. Moreover, the continuous depletion of unrenewable oil and gas reserves, combined the existence of alternative bio-based chemical makes petrochemical industry the least sustainable compared with the other two.</p>

## 5.2.4 Input for case study

For convenient, summary of the analysis from the previous sub-section presented in the table below. This data would be used as the main reference for the case study in the following chapter.

*Table 18 Summary of PoKT Financial and Added Value evaluation*

Variables	Alloy cluster	Petrochemical cluster	Bio-based cluster
Business case (DCF-based NPV)	- 105,95 M USD	- 110,26 M USD	- 109,66 M USD
Decent work and economic growth (SDG – 8)	Employment multiplier = 3,7	Employment multiplier = 6,3	Employment multiplier = 5*
	Source: <a href="http://www.contentfirst.com/multiplier.shtml">http://www.contentfirst.com/multiplier.shtml</a>		
	Direct jobs created = 5.000 worker	Direct jobs created = 2.000 worker	Direct jobs created = ~2.000 worker
	Source: Rebel Economic Impact Assesment (2017) slide 16		
	Indirect jobs created = ~18.500	Indirect jobs created = ~12.600	Indirect jobs created = ~10.000
	Economic growth = High	Economic growth = High	Economic growth = Medium-High
Industry, Innovation and Infrastructure (SDG-9)	Industry = High Innovation = Medium Infrastructure = High	Industry = High Innovation = Medium-Low Infrastructure = High	Industry = Medium Innovation = High Infrastructure = Medium-High
Sustainable cities and communities (SDG - 11)	Moderately sustainable	Less sustainable	Highly sustainable
Life below water (SDG - 14) Life on land (SDG - 15)	Relatively high risk due to ship breaking activity if not regulated carefully	Controlled and well regulated risk introduced by refineries and toxic products	Minimum risk to the environment due to natural product. Risk may come in poorly regulated feedstock farmers

## 6 Reflections

### 6.1 Introduction

This chapter would illustrate how the research products would contribute to port planning especially in the case of PoKT. In doing so, this chapter have been constructed using the following format:

- This chapter would contain three section with one section for every research products (Developments analysis, Port Masterplan, and 1<sup>st</sup> phase layout)
- Each section would contain:
  - A general information sub-section, which contain the generalized case study that is applicable to other port projects. A summary of relevant information that are taken into account in the PoKT decision making process would be presented as the main case study object.
  - PoRA perspective sub-section, presenting the collective result from interviews, focus group discussion, and questionnaire sessions with PoRA experts regarding PoKT port planning process. In this sub-section, all analysis would be performed based on PoRA point of view. The objective of this sub-section is to discuss the implication of the research product based on realistic/pragmatic point of view. For more information regarding the data collection process (interview, questionnaire, or discussions) with PoRA experts, please refer to Appendix E and F.
  - Researcher perspective sub-section, contains the third person view analysis conducted by the author. All analysis in this sub-section would be conducted based on the *Value Driven Stakeholder* perspective. The objective of this sub-section is to discuss the implication of the research product based on idealistic point of view.

For simplicity, all relevant information have been extracted from the discussions with the experts and applied in the report. As a result, a comprehensive analysis of port planning was produced which is unique to the project and research objective. Therefore, a direct application of this report analysis to other port projects, except for the “General information” sub-section is no recommended. A sufficient study on any port project background would be required before using the research findings in this report to ensure their compatibility and avoid unwanted outcomes. It is worth noting that efforts has been done to contact some of Indonesian experts that are relevant towards this research. However due to time and accessibility constraint, none of these experts are available. As a substitute, the “Researcher perspective” sub-section have been provided, where the PoKT project was assessed outside the PoRA perspective.

### 6.2 Developments analysis for ports

#### 6.2.1 General information

Among the nine developments described in Section 2.2, the coalition of shipping lines proves to be the most disruptive developments affecting large scale port that serves inter-continental shipping route (i.e., Port of Rotterdam, Port of Melbourne, Port of Tanjung Priok, and Jawaharlal Nehru port). These ports would be forced to update their facilities following the ship size and schedule of the shipping alliance fleet to remain competitive.

As a result, the whole sea-route transportation system would become even more efficient. In the end, the consumer living in the hinterland would receive benefit through lower logistic cost generated by the system high efficiency. However, port authorities and local government must play an active role in synergizing their development plans. Without proper integration, significant congestion might happen in the hinterland main road corridor due to increase peak of traffic at the time of large vessel cargo discharge. As for smaller scale feeder ports, the coalition of shipping line developments would not affect them as heavily as the hub ports. These feeder ports however, should also prepare themselves for changes in throughput patterns in the future.

Another important disruptive developments affecting large scale ports is the multi-national company partnerships. As result of the internet and other related technologies, now the world is more connected than ever. Companies in different continents can reach each other to work together and seek new opportunities (I.e., PoRA and Sohar JV, and PoRA and Pelindo 1 JV). To become successful, these partnerships also need to play close attention to the difference in corporate and country culture, distinctive local regulation, dynamics of relevant government support and land acquisition. Where as in a case of other stand-alone ports, the distinctive local regulation developments can be neglected, since the governing regulations would always be similar with the previous one. As for government support, the port would always require it regarding permits and regulations. For government financial support, it would depend on the business case of the port project (either green field or extension) and the added value that the port could bring into the surrounding region.

The relationship with neighboring ports and special economic zones are developments that are relatively more stable compared with the other developments. These developments are most relevant for ports that positioned close to rival ports in the region (i.e., Ports in Hamburg-Le Havre range). However, for other ports that are positioned away from their competitor, these developments might appear less important. For example, all ports in Sulawesi Island, Indonesia are regulated under the Pelindo 4. Unlike in the Netherlands, where ports are regulated by the port authority in their respective city. Therefore there would be minimum to no competition occur between ports that are located on this island which then results in lower efficiency compared with Ports in Java island where Pelindo 2 ports compete with Pelindo 3 ports.

Lastly, the dynamics of international standards & organization and port related technology development can be seen as merely a supporting developments. It is obvious that if a new robust technology that improves port operation efficiency has been developed, all competitive ports would be attracted to purchase or apply it. The same reasoning also applies to new international standards or recognition by the international organization, where all competitive ports would perform their best to meet these standards. Therefore while it is important to keep a watching eye on this developments, a port developer should not devote much of their attention to studying these developments as they are not as dynamic as the coalition of shipping lines or the multinational company partnerships.

### Summary for PoKT case study:

The ambitions set for PoKT is that in a long term, this port would serve as international hub port (large scale port). To do so, Pelindo 1 and PoRA has decided to create a joint venture to develop this port. As a port that is being built in Malaka Strait region, PoKT offers a promising market opportunity for its investor due to its populous hinterland and dense traffic of Malaka Strait. Furthermore, by fulfilling its role and Indonesia international hub, it would serve as transshipment for an even more populous western side of Indonesia, generating more cargo flow. However, just like other ambition, PoKT needs a starting point. Currently, as a green field port, PoKT do not have any income (since it is not operational yet) while having extensive capital investment needed for its basic infrastructures resulting in a tough financial condition in its early stage.

## 6.2.2 Developments analysis: PoRA perspective

Based on discussions with PoRA experts, it is concluded that the rank of importance of these developments towards PoKT development would depend on the exposure of an expert towards the project and the project phase itself. It should be clear here, that the effort in ranking the developments is only a matter of prioritization to enable a more structured problem-solving approach for the project organization in the future. Therefore it does not necessarily mean that least prioritized developments are not important. They should also be kept in check regularly, but not as often as the high ranking developments. Because even if changes do occur in the low importance developments, the effect on PoKT would be minimal compared to the high ranking developments.

Ideally, the PoRA experts would be classified into three categories based on their level of exposure towards the project. However, for simplification, the PoRA experts would divided only into two categories as depicted in the figure below.

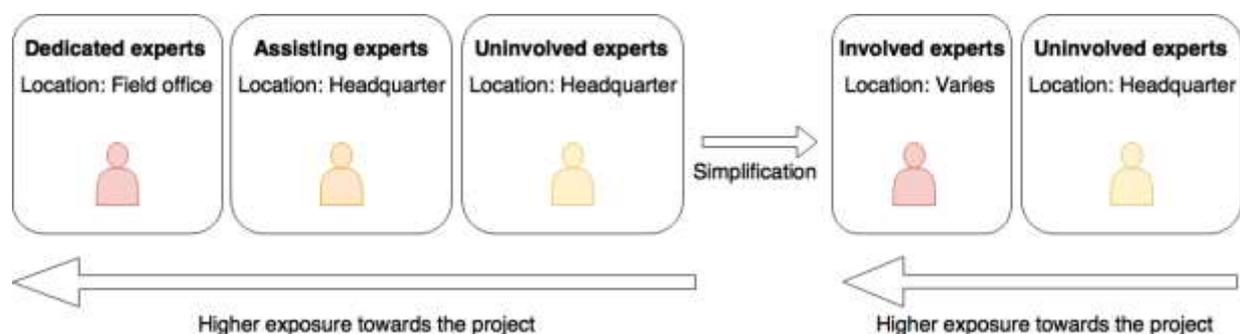


Figure 23 Classification of PoRA experts based on their exposure level towards PoKT project

The main difference between each expert category is the amount of dedicated working hour they spent towards the PoKT project. Dedicated experts spent their full-time working on the project while assisting experts to do their part of job occasionally when necessary and uninvolved experts do not spend their time at all on the project. As a result, involved experts (both dedicated and assisting experts) have a more up-to-date information on the project. They are more focused on resolving the short-term goals to enable the Port to be operated profitably as soon as possible. On the other hand, uninvolved experts are more focussed on long-term goals by indicating all possible challenges that might appear along the road after PoKT being operated.

To enable a more in depth discussion, emphasize would be placed on the analysis of top three most important developments to PoKT. The result of the discussion with the PoRA experts is summarised in Table 19. In general, all of them do agree that all the four developments stated in the Table 19 would play a significant role in PoKT development. However, their importance rank towards the project is difficult to be determined. For them, it is not so important to decide on the rank of developments. Because in the end, they do need to be successful in all of these developments.

*Table 19 Top three most important developments for Port of Kuala Tanjung*

Developments ranking	Involved experts	Uninvolved experts
1 <sup>st</sup>	Multinational company partnership	Relevant government support
2 <sup>nd</sup>	Relevant government support	Multinational company partnership
3 <sup>rd</sup>	Relationship with neighbouring ports	Dynamics of land acquisition process

Currently, the PoRA project team (the involved experts) adopts a pre-planned approach with a tendency towards opportunity driven decision making. That means that they have decided on certain goals to be met within a specified duration of time. However, they are reactive to adjust their approach towards the project depending on the condition they faced in the field. For example, since port regulation in Indonesia and the Netherlands differs, PoRA would need to adapt its port governance model to fit with Indonesia framework. For instance, since in Indonesia, most strategic companies are dominated by the state owned enterprise, a standard tender approach to decide on the first industrial tenant would not be suitable. Therefore the project team decided to go with a bilateral approach to attract their first industrial tenant.

Getting back into Table 19, consensus has not been reached between the *Involved experts* and the *Uninvolved experts*. In the case of the *Involved experts*, they are defined as a team that is focused on making the PoKT project successful. To do so, they have to be aware of any roadblocks as well as any opportunity on day to day basis. This mindset keeps them responsive and agile enough to adapt according to the project condition. The weakness that the *Involved experts* might have is their perspective is somehow too anchored into the current project condition. This behavior is understandable since it is their role to continuously provide an objective assessment of the project under "as it is" condition. Their assessment would then be used by the decision makers within PoRA to decide the future of the PoKT project.

The *Involved experts* conclude that improving their relationship with Pelindo 1 as the JV partner is their top priority (Multinational company partnership). Due to major differences between Indonesia and the Netherlands culture and legal framework, it is paramount for them to have a local cooperative partner that can solve a problem together with them in locally accepted ways. But first, they need to share the same vision which is currently being worked out with the board member of each company<sup>12</sup>. However, they have stated that it does not mean that they would choose a "good partnership" over a "good government support," since both of them is equally important. The project can not be realized without the existence of these two elements. As a thought exercise, a question follow-up question has been given to the involved expert as follows:

*"If you need to choose one, would rather have a "cooperative partnership but less government support" or a "good government support but uncooperative partnership" ?"*

<sup>12</sup> For further explanation regarding the differences between PoRA and Pelindo 1 please refer to page 25 and 49

It is a tough question for them. However, if they need to choose, they are in favour of “*cooperative partnership but less government support*”. Their arguments are as follows:

- First it should be clear, that even though the government do not support us (PoRA), they would not actively working against the project. Therefore PoRA still can process the permits under normal condition. If the government have stated that they are not in favour of the project, then it would be extremely difficult to continue the development.
- We (PoRA) choose partnership over government support because, if we have a cooperative partner, we can work together actively to find the best possible solution, despite of how hard the condition might be, in which both party agree. By doing so, we would be able to bring out the best of both world.
- However, even if we (PoRA) do have a good government support, without the existence of the local partner it would be difficult to translate the vision into concrete actions that is acceptable by Indonesian standard.

For the third most important developments, the *Involved experts* agreed in choosing the “Relationship with neighbouring ports”. This developments is important because the number of competitor in the region along with their cargo segment expertise would also affect the strategy of PoKT 1<sup>st</sup> phase development. Ideally, the PoKT should avoid direct confrontation at all cost with the competitor in the 1<sup>st</sup> phase development. Because at the early stage, PoKT would still need to recover its financials after spending extensive cost on basic infrastructure. Moreover, the cargo traffic in PoKT would not be as stable as its competitor in its early days <sup>13</sup>.

Next, according to the *Uninvolved experts*, government support is more important than the relationship PoRA had with the JV partner. By support, they means in terms of permits and not financial support. Because for every port project, government support regarding permits or other legal advice is crucial. Without this, PoRA cannot develop any port in a different country than the Netherlands. On the other hand, government support regarding financial is only needed if the project has a negative business case. In case of the relationship PoRA had with the JV partner, it would be constructed naturally. As long as there is strong market opportunity in the region, both company would do their best to adjust to each other needs in order to gain profit for both company. Whereas for the third most important developments, they have difficulty in deciding between “land acquisition” and “relationship with neighbouring ports”. Because both of them are equally important.

Previously, the *Involved experts* was selected “land acquisition” as one of most important developments. However, they decided to exclude it from the top three rank, because “land acquisition” can be seen as the by product of government support. If the PoRA have a good government support in developing a port abroad, then they would not have a problem with the land acquisition process.

The *Uninvolved experts* offered a different persepective. According to them, land acquisition and government support are two separate thing. They are somehow correlated, but cannot be assumed as one singular object. Because, if even the PoRA do have a strong government support in a region, it does not guarantee that the land acquisition process would progress smoothly. Government support is a very broad term. It could be interpreted as the government actively supporting the project by conducting stakeholder management with the local inhabitant. Or, it could also be interpreted that the government pasively support the project by providing permits as fast as possible. It also means that the government would not do more job outside their standard responsibilities. In conclusion, the *Uninvolved experts* suggest to keep “land acquisition” and “government support” separate and decides that land acquisition is a little bit more important than the “relationship with neighbouring port”. Because it is obvious that without a land, there would be no port at all.

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<sup>13</sup> For futher explanation regarding the situation with neighbouring ports please refer to page 33

### 6.2.3 Developments analysis: Researcher perspective

In the previous sub-section, the three most important developments relevant to PoKT project has been selected based on the PoRA experts consideration. The original objective of this ranking is to identify key issues relating to PoKT project that all experts can agree upon. By doing so, they could focus on solving these problems one by one. However, after observing the nature of the project, it is concluded that it is not necessary to rank the developments based on level of importances. Because, the level of importance of each developments would always change depending on the observer perspective and phase of the project. Moreover, since PoRA team works based on an opportunity driven decision making, the main objective of the ranking mechanism would be obsolete<sup>14</sup>.

Therefore another another approach would be proposed to help the PoRA team improve their project management. It is by grouping, instead of ranking. The main consideration in selecting this approach over ranking is to maintain the balance between the elements of certainty and uncertainty within the project. Ideally, a standardized framework is more preferable which allows a replication of a project procedure in another project or to maintain management quality control (suitable for *Disruptive dominated*<sup>15</sup> projects). However, for green-field port projects such as PoKT, there is still considerable amount of uncertainties originating from various sector (*Uncertainty dominated*). Having a rigid, well-defined framework would affect negatively towards the team responsiveness and adaptability. Therefore, leaving some room for flexibility in the project execution is a better approach in this phase of the project.

Table 20 Grouping of developments relevant to PoKT in the 1<sup>st</sup> phase development

	Developments Relevant to Port of Kuala Tanjung
Top priority	Multi-national company joint ventures
	Dynamics of relevant government support
	Relationship with neighbouring ports
	Dynamics of land acquisition process
Middle priority	Distinctive local regulation
	Special economic zone
	Dynamics of international standards
Lower priority	Port related technology development
	Consolidation of shipping line

In Table 20, the developments haven been grouped by using the discussion with the PoRA expert as a reference. The exact order of the developments in the same group does not really matter. It is important to note here, that this grouping might change in the future once the project has gone further.

For instance, in construction phase, the port related technology development would go up into top priority, and if PoKT have become fully operational and able to serve big size vessel,

<sup>14</sup> Because as mentioned before, the use of the ranks is to determined key issues to be solved one by one sequentially. In an opportunity driven approach, the order of problems that are being solved is depended on existing opportunities and cannot be decided before hand.

<sup>15</sup> Please refer to page 22 for further explanation regarding the project evolution phase.

the consolidation of shipping line would become the top priority while government support aspect would lower importance.

According to the analysis, it is important to further discuss the relationship between PoKT with the neighbouring port. So far, the relationship between PoKT with the neighbouring ports has been classified to be either competitive or non competitive. This way of classifying is useful for developing the PoKT commercial strategy. However, Indonesia government also have other ambitions for PoKT as a national strategic project. It is to make it as one of the hub port of the “Tol Laut” network. Therefore, in its development, PoKT authority should have a clear plan in how to integrate its services with other Indonesian port. If PoKT do able to become a self-sustainable port, then the JV would see it as a successful project, however in the persepective of Indonesian government it would be a partial lost if PoKT cannot be integrated into the “Tol Laut Network”.

Another developments that requires additional attention is the “special economic zone”, or in this case the Sei Mangkei zone. Previously it has been explained that in general, PT Perkebunan Nusantara 3 (PTPN3) as the one of the biggest palm oil company that is based on Sei Mangkei is supportive towards PoKT project<sup>16</sup>. However, the condition for their support is that PoKT should not become their competitor in Palm oil Industry. This condition would be difficult to be fulfilled, since according to the analysis the most promising industrial cluster is the Bio-based cluster. In Bio-based cluster the palm oil would act as the main feedstock for first industrial tenant, which is the bio-etanol plant<sup>17</sup>. It should be noted here, that it is not in the best interest to have a direct competition in palm oil industry with the companies in the Sei Mangkei zone. Therefore the JV is strongly advised to work on solution with the palm oil industries to enable synergy which benefits both parties. It could even be in a form of Holding company or another Joint venture. In principle, the competition between PoKT with palm oil industries in Sei Mangkei should be avoided at all cost as it would hurt the project significantly in a long term. It is more beneficial for both parties to synergize and create a world class bio-based cluster.

And the final developments that is to be discussed is the “Port related technology development”. Nowadays, leader in the port industries prefer to use automation technologies to further optimize their operations. In a case of PoKT, automation technologies should be used in moderation. Emphasize should be given on technologies that preserve labour intensive activity to create more jobs. Nonetheless, the priority in the 1<sup>st</sup> phase development is to apply construction technologies that would reduce the CAPEX to make the business case more positive.

In an effort to further optimize the PoRA team project management, another recommendation would be proposed, besides grouping the developments. Which is a periodical meeting between the *Involved experts* with the *Uninvolved experts* which could be named “Rejuvenating meeting”.

The advantage of having a Rejuvenating meeting is that it keeps the perspective of the *Involved expert* calibrated with the ‘Ideal situation’. If the *Involved experts* only discuss or brainstorm their projects with other *Involved experts*, they would tend to see things as “the most probable scenario”. While this kind of persepective has its own merits, if not kept in check, this environment would stimulate *false dichotomy* or *arguments from authority* logical fallacy. *False dichotomy* implies that there would only be two possible outcome for any given situation. While *arguments from authority*, implies that any arguments given by an expert could be true even without a proof. The role the *Uninvolved experts* in Rejuvenating meeting is to challenge the conclusion that *Involved experts* have derived from different angle, and also to participate in a brainstorm session if necessary. By doing so, *Involved experts* could benefit by having fresh ideas or perspective to solve their delicate problems.

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<sup>16</sup> Please refer to page 33 for further explanation regarding the Special Economic Zone

<sup>17</sup> Please refer to page 62 for further explanation regarding the first industrial tenants alternatives

## 6.3 Port of Kuala Tanjung Masterplan

### 6.3.1 General information

The adaptive port planning framework have been used to make the existing masterplan adaptive. The concept of the adaptive masterplan is that “the end picture of a port dynamic.” That means, every masterplan should have an “expiry date” and should be renewed periodically to maintain its validity with current market situation. Because as time progress, not only the forecast that is made today might be proved to be incorrect, but also the information that is used in making those forecast could also change. Thereby, using a stationary masterplan would be dangerous nowadays. Therefore, the adaptive port planning should be applied to all other ports worldwide.

During the research, a way to make a port more resilient towards a fluctuating cargo flow has been discovered. It is by creating a port industrial complex. The benefit of making this complex is the port would have secondary, more stable income from lease fees. Moreover, by having industrial companies in the port, there would be more jobs created and a relatively stable cargo flow generated by the influx of feedstocks required by those industries and outflux generated by the product of those industries. However, a port industrial complex is not suitable for all ports worldwide. To apply this concept, a port should be commercially feasible. To become commercially feasible, these ports require a populous hinterland, availability of feedstocks, and existence of supporting infrastructure. Therefore for an archipelagic country such as Indonesia, a port industrial complex is only feasible to be located in its mainland (i.e: Sumatera {PoKT}, Java, Kalimantan, Sulawesi, and Papua). As to increase the robustness for small ports in the small islands, another solution still needs to be discovered.

### 6.3.2 PoKT Adaptive Masterplan: PoRA perspective

During the discussion, the PoKT has been divided into three layer, which is *Physical Infrastructure, operation and management, and product and service layer*<sup>18</sup>. Then, the most important “opportunities or vulnerabilities” PoKT was identified for each layers. Similar to the developments, the experts cannot reach a consensus. Because, some aspects are equally important and PoKT cannot be constructed or operated without these aspects. For instance, in *Physical Infrastructure* layer, most experts selected the “Resilience port, relatively independent from global economic and political situation”. Because it suites their vision to realize a port which able to withstand the most plausible scenario in the future. In order to do that, one of their solution is to built a port industrial complex just like port of Rotterdam. Their main reason behind the concept, is to “generate **captive cargo** due to the existence of the industrial tenants” and “promote usage of **shared facilities** within an industrial cluster”. Captive cargos defined as flow of goods that stays within or send directly from North Sumatera. The component of these captive cargos are imported feedstock and exported product of the industrial tenants; and imported and exported product from other user in the hinterland. Since these industrial tenants need to maintain their production to maintain their own profit, therefore the captive cargo considered relatively stable. Meanwhile, the benefit of “promoting usage of shared facilities within an industrial cluster” is to enable higher efficiency into the port system. By doing so, the port authority can manage the schedule of the shared facilities to enable higher utilization while the industrial tenants could do some saving by not building these facilities<sup>19</sup> on their own. However, the “Financial condition to arrive in its mature/stable condition” is also important.

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<sup>18</sup> Please refer to page 48 for more information

<sup>19</sup> Shared facilities: Common facilities that are required for any industry under the same industrial cluster (i.e: breakwater, road, rails, pipelines, electricity grid, sewage system, clean water system)

Because, to arrive in its mature stage, PoKT have to be built in phases. In every phases, the JV would have spend considerable investment which would substantially affect the port financials. In another word, the “Resilient port” would act as guiding principle or destination in every development stage, while the “financial condition” would act as deciding factor or “motor” for the development to actually take place. The balance between these two element is paramount one cannot really say which one is more important.

In *Operation and Management* layer, the *Involved* and *Uninvolved* experts also do not arrive in a consensus. For the *Involved* experts, “Autonomous project organization” is the most important aspect, while for the *Uninvolved* experts, “The success rate of integrated port industrial complex” is more important. “Autonomous project organization” defined as the capability of the project organization to act **independently** from the JV to handle **operational decision making**, while the **strategic decision making** was conducted by the JV. The main difference of both of these type of decision making originated from the type of problems being handled. Operational decision making is required to handle problems that needs to be solved in a short-term (under three months) and do not have significant impact towards PoKT long-term performance such as day to day operation problems.

On the other hand, strategic decision making are required to address long-term issues that might affect PoKT in the long-term such as political or commercial strategies. The exact items that are listed under each type of decision making has to be agreed upon before PoKT goes operational between the project organization and the JV. The division between the items needs to be done as clear as possible to avoid confusion or mismanagement. In a case where it is unavoidable, the decision can be taken in the quarterly meeting where the board members of the JV and the executive staff from the project organization met.

This management concept is important for PoKT. Because as a JV greenfield port, PoKT has to face the challenges introduced by both of these elements (joint venture and greenfield port). If all decision making were conducted by the same decision makers, it would severely reduce the responsiveness and quality of the decisions being taken. Board members of PoRA and Pelindo 1, has the capability to look into the bigger picture of the project, enabling them to predict the rough future condition of the project. This ability is best suited for strategic decision making. However, for the short term challenges and opportunities, the project organization are more aware then the board members, simply because they are more exposed into the project. Therefore, they have better competence to conduct operational decision making. By applying this management model, PoKT project organization would become more responsive and agile, while maintaining its consistency to realize the masterplan. An illustrative figure on this management model can be found below.

The *Uninvolved experts* have **different** opinion on the most important aspect on the *Operation and management* layer, even though they do agree that “Autonomous project organization” is indeed important. Their main argument, is that designating authority within the internal JV organization is only a temporary problem. As long as there is a clear mutual benefit obtained for both party, eventually the JV would decide on a model that is acceptable for both PoRA and Pelindo 1. The most important problem for PoKT in their perspective, would be “The success rate of integrated port industrial complex”, which is strongly determined by the relationship PoKT had with its industrial tenants. Because, in the end, the whole ambitions and prospects that are expected from PoKT could only be realized if the project does consistently profitable. Therefore, if the commercial aspect of PoKT is more important than the internal management of the organization itself. Lastly, they also indicate that the prioritization on the list of “opportunities or vulnerabilities” in the *Operation and management* layer could not be as it is. Because in the list, there has been a mix of internal and external management issues which is equally important. These issues needs to be separated in order to allow practical prioritization. Suppose that the *Operation and management* layer indeed being separated into internal and external, they would choose “Autonomous project organization” as the most important aspect in the internal part and “The success rate of integrated port industrial complex” in the external part.

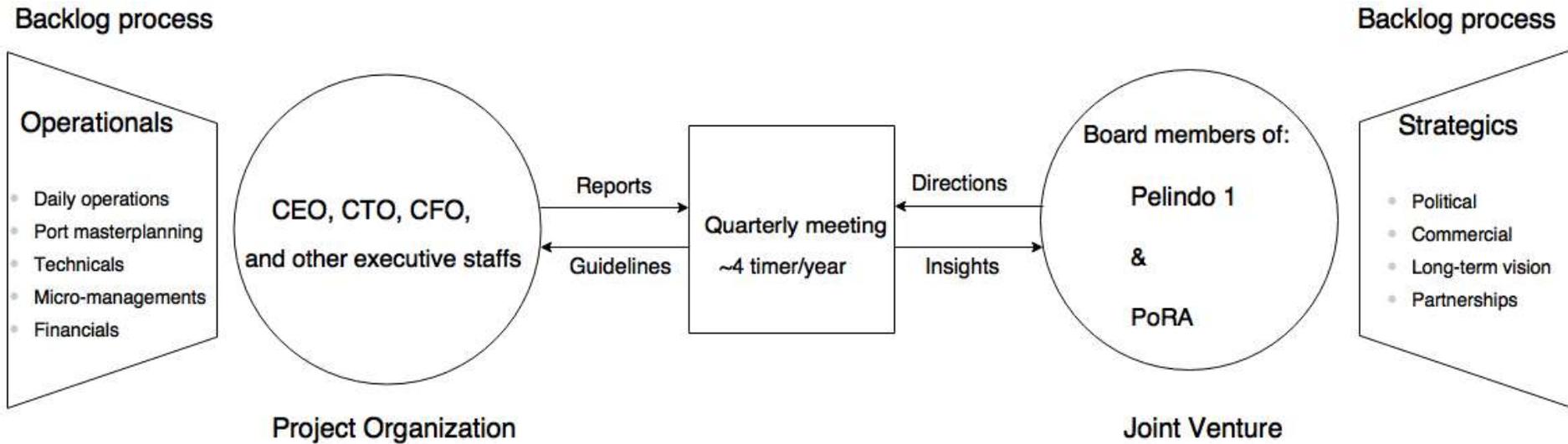


Figure 25 Autonomous Project organization management model (source: author)

Next, in the *product and service* layer different approach was taken, because only one opportunity or vulnerability was discovered. In this layer, instead of asking the experts which aspect is the most important, a brainstorm was conducted to come up with other from of revenue for a land-lord port model other than lease fees and port dues. The discovered alternative source of income from the discussion listed as follows:

- Utilities fee:

The fees that are charged towards terminal operators and industrial tenants for using the port utilities such as electricity, water, and sewage system. The method of payment might different depending on the port. It could be charged based on volume or on timely basis.

- Equipment/suprastructure fee:

In a case where the terminal operators or industrial tenants cannot afford to procure their own equipments/suprastructure, they might ask for the port authority to made it available for them. If it does happened, the port authority would then charge them for renting the specific tenant facilities.

- Opportunity lost fee:

For a special case where there is an activity that do not provide the port authority any profit but generates significant added value into the region, a modified approach is required. The concept is that the company that held the special activity should pay the same amount as if a normal/familiar company operates at the same given condition. For example, in the case of Offshore platform maintance in Port of Rotterdam which do not generate any cargo (no port dues) and do not occupy any land slot (no lease fee). Therefore, port of Rotterdam do not acquire any profit from this type of activity directly. However, since it generates significant jobs to the region, the port has no reason to forbid it. Using the concept of opportunity lost fee, the port should charge the owner company of the offshore platform the average amount as if a normal cargo vessel berthed under the same quay length and idle time.

- Consultancy fee

As an effort to diversify its income, PorRA has launched a consultancy service worldwide. The consultancy theme, revolves around the company's expertise, which is to built, regulate, and manage a port. Their client are other port authorities worldwide, such as port of Pecem, Buenos Aires, and Mozambique

- Joint venture dividend

Just like companies in other sectors, port authorities also started to joint hands with its partners from other countries to capture new opportunities originated from different market demand in its hinterland. For example, PoRA has made joint ventures with the Oman government to construct port of Sohar and with Pelindo 1 to construct Port of Kuala Tanjung. Port of Antwerp also have made a joint venture with the Oman government to construct port of Duqm (PoA, 2012). As observed, the developments of multinational company partnership<sup>20</sup>, where in this context is a port authorities joint venture is expected to continue.

By exploring other alternative source of income, a port robustness could be improved. However, such discovery might alter the definition of a land-lord port<sup>21</sup> itself. Because the widely accepted characteristics of a land-lord port model, is that the port authority do not operate the port directly and only act as regulator and masterplanner. However, in one of the discovered options, the port authority would also act as a consultant for other ports which is clearly not described in the business model of a land-lord port model.

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<sup>20</sup> Please refer to page 19 for more explanation on "Multinational company partnership" trend

<sup>21</sup> Please refer to page 4044 for the definition of a land-lord port

As a response towards the ever changing world, ports governance model also cannot stay the same. They need to adjust not only their physical infrastructure, but also their management and business model according to their needs. Therefore it is concluded that it would be hard for a purely “land-lord” port to stay competitive in this modern age. Even PoRA might not longer be able to be called a fully pledged “Land-lord” port.

### 6.3.3 PoKT Adaptive Masterplan: Researcher perspective

In developing PoKT, PoRA team have shown various creative ideas to overcome problems unique to PoKT project and realize Indonesian government ambitions to make PoKT as Indonesia International Hub Port. For instance the concept of port industrial complex, which enables PoKT to generate captive cargo and become self-sustainable on its own. However, to develop a port industrial complex within Indonesia legal frame would be a challenge<sup>22</sup>. Therefore, a tailored approach would be required in order to develop PoKT in accordance with the shared vision of the JV and Indonesian government. Currently, negotiations and other efforts are still on progress in order to provide PoKT with special status to enable industrial port complex to be constructed. Ministry of Transport in this context has shown its full support in realizing the special status.

Following the format of the previous sub-section, the analysis on PoKT masterplan based on the research perspective would be elaborated sequentially from the *physical infrastructure, operation and management*, until *product and service* layer. In the *physical infrastructure* layer, it is worth noting that PoRA masterplan version has already contained adaptability property which is reflected by their “no-regret” philosophy in phasing of the project. Due to this philosophy, PoRA has been able to reserve some “room for adaptation” in each phase of PoKT development. However, there has been one substantial difference between PoRA masterplan design with both Indonesia Ministry of Transport and Royal HaskoningDHV design. PoRA masterplan would use reclaimed land for the container terminal area, while the others used an offshore deck-on pile jetty. The main reason why PoRA masterplan is in favour for reclamation is to enable a more integrated system between the container terminal and the port industrial complex by placing them near to each other. On the other hand both Indonesia Ministry of Transport and Royal HaskoningDHV choose to avoid reclamation, because the price for reclaimed in Indonesia is simple to expensive. Moreover, Kuala Tanjung area has a weak soil. Whereas, a container terminal would induce a substantial load on the soil due to their heavy cargo. Therefore considerable land improvement would be required to enable PoRA’s container terminal layout which would add more burden to the project business case in the next phase. A more detailed study on design alternative of container terminal and how to integrate it with the port industrial complex is required to ensure the optimal alternative.

In *operational and management* layer, it has been observed that PoRA experts makes their decisions based on market analysis. They conducted various study to measure objectively the attractiveness of an investment opportunity. Their judgements on a projects are therefore considered quite pragmatic and conservative and influenced by their experience in developing Port of Rotterdam and Port of Sohar. As a result, PoRA contribution in PoKT development could increase the project attractiveness as a commercial port. However, the ambition of Indonesian government on PoKT is not only for the Port to be profitable, but also to become the backbone of the “Tol Laut” network. In addition to that, in the government perspective, the added values which PoKT could bring is as important as its commercial capability. Even though PoRA has conducted Social Economic impact on PoKT and committed to promote added values in PoKT, as a corporate company, they simply does not have the capability to ensure Indonesian government non-commercial goals would be realized.

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<sup>22</sup> Please refer to page 3 for more explanation regarding Indonesia legal frame within Port context

This task should also not be given to Pelindo 1, because even though they are state-owned company, they are still a company which focused on earning profit. The recommendation would be to establish a committee to continuously monitor PoKT development transparently. This committee should consist of government officials, NGOs, local inhabitants, and other relevant stakeholders. To maintain consistency and credibility of the committees, the ministry of transport is recommended to act as steering committee as they are the main government representative that is involved in this project.

Finally in *product and service*, PoRA has shown multiple ways to adapt PoKT source of income according to different scenarios. The PoRA flexible way of thinking in this regard could be caused by its corporate culture. Since its early days, Port of Rotterdam has to face competitions both in local level (with Delft, Amsterdam and Dordrecht) and regional level (with Hamburg and Antwerp). The highly competitive region thus forced Port of Rotterdam to keep improving their performance whether in infrastructures or services. As a result, Port of Rotterdam always adjust their commercial strategy depending on the situation of the port. This way of thinking is different with the Pelindos where they could regulate all ports within their region. As a result, competition between Indonesian ports are relatively low with some exception such as Port of Tanjung Priok (under Pelindo 2) and Port of Tanjung Perak (under Pelindo 3). The difference in their background and legal framework results in different types of expertise. Port of Rotterdam has the capability to develop and manage a large scale commercial port in a sustainable way. While the Pelindos have the capability to regulate **multiple** various size Indonesian ports within the Indonesian framework. Seamless synergy between both entities is paramount for the success of PoKT development.

## 6.4 1<sup>st</sup> phase development

### 6.4.1 General information

Most green-field/1<sup>st</sup> phase port development in the world, has the same fundamental problem. To build the essential infrastructures, huge investments are required up-front. On the other hand, the income generated by the port activity could only be started when the port starts being operational, typically 2-4 years after the start of the construction. Adding to the previous fundamental problem, as the world becomes more dynamic and unpredictable<sup>23</sup>, the traditional port business model which relies heavily on cargo throughput becomes more volatile. As a result, green-field port development is considered as a high risk investment by banks or investors.

Consequently, green-field port developments are often conducted by private companies for their own usage or by a government. In the case of private companies, they have reduced amount of uncertainty originated from the cargo throughput volatility, since the port would be mainly used to handle their own cargo. Whereas in the case of government port, subsidies or other type of incentive would be given to the port by the government to support the port financially in its early stage. For other special cases such as PoKT, a more tailored approach is required.

As a national strategic project, PoKT could be called a government port. However since the port operator (Pelindo 1) is considered as state-owned *entreprise*, the PoKT would then cannot be determined as a fully government/non-commercial port. It has a hybrid objective. On one hand, PoKT should be profitable in order to serve its cause under Pelindo 1 and PoRA management as a commercial port. On the other hand, PoKT should serve the other ports within Indonesia "Tol Laut" network as an international hub under the influence of PoKT port authority.

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<sup>23</sup> Please refer to page 16 for more information regarding developments affecting ports worldwide

Since both Pelindo 1 and PoRA has no capability to generate cargos as the private companies mentioned in the previous paragraph, they could not stabilize the cargo throughput in PoKT to ease the port 1<sup>st</sup> phase financial burden. Therefore, as a solution for the fundamental problem, an industrial port complex concept<sup>24</sup> was introduced. By using this concept, the JV intends to stabilize the cargo throughput and create additional source of income through lease fees from to the existence of industrial companies. However, even with this concept, in the best scenario the NPV of PoKT is still negative<sup>25</sup> based on DCF business case calculation method. Therefore, a government support is required to make the project commercially feasible.

Based on the research in the previous chapter, currently PoKT has three alternatives for its development. It is either an alloy, bio-based, or a petrochemical cluster. A case study based on the summary of information presented on Table 18 and focus group discussion (FGD) with PoRA experts was conducted in the following sub-section to select the best type of cluster for PoKT 1<sup>st</sup> phase development.

#### 6.4.2 PoKT Robust 1<sup>st</sup> phase development: PoRA perspective

As a commercially driven company, PoRA weight their decisions based on the combination of market, stakeholder, financial and technical analysis. By taking into account all various development in the project, it would be difficult to select the best cluster for PoKT as each cluster has their own strength and weaknesses. Ideally, PoRA would like to attract bio-ethanol (bio-based cluster) producer companies as a launching client to kick-start PoKT development. The main reason for this is because, unlike the other cluster alternatives, there is **existing** abundant amount of palm oil supply from Sei Mangkei area as a feed-stock for the bio-ethanol companies. From commercial and financial perspective, the existence of the feedstocks which reduce uncertainty and therefore reduce the risk imposed to the project. Lower risk means a more attractive project for investors and financiers which would therefore results in a more profitable port. However, currently this option faced a roadblock. The SEZ area, "Sei-mangkei" has stated their interest in developing a downstream palm oil based industry in their area. The new Sei Mangkei interest, indicated that the industries which resides within the area are stating to expand their business from only palm oil production to palm oil processing. Therefore, if PoKT decided to develop a bio-based industry in within its port industrial complex, there would be a conflict of interest with Sei-mangkei. This condition should be avoided at all cost as it would not benefit PoKT in anyway. As a result, the decisions or planning that has direction towards bio-based cluster is relatively postponed, until further negotiations or developments occur with relevant parties such as Sei-mangkei.

Petrochemical cluster on the hand, has become the least favourable option in this stage. Even with the largest commercial opportunity compared with the other cluster, building the petrochemical cluster would impose high risk towards PoKT. Because, to attract large number of petrochemical companies into the cluster, existence of oil refineries within the port complex is paramount. Currently, Pertamina the Indonesian state-owned oil company has stated that they have no interest in building refineries in PoKT. Moreover, there is also no plans to build regasification unit for natural gas in PoKT because there is already regasification unit nearby. These conditions would therefore significantly reduce PoKT petrochemical cluster commercial attractiveness. Without the existence of oil refineries or natural gas regasification unit, building a profitable petrochemical cluster would be very difficult. As a result, the decisions or planning that has direction towards petrochemical cluster is postponed, until further negotiations or developments occur with relevant parties such as Pertamina.

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<sup>24</sup> Please refer to Figure 21 for the port industrial complex model

<sup>25</sup> Please refer to Section 5.2.2 for Port of Kuala Tanjung Business case

Continuing to the Alloy cluster. This cluster has relatively moderate commercial opportunity compared with the petrochemical cluster. The amount of cargo throughput volume generated by this cluster and the versatility of its downstream product is not as high as petrochemical cluster. Moreover, to handle alloy cluster cargos, a dry bulk instead of liquid bulk terminal is required, which is more expensive. Therefore, in ideal situation, PoRA would choose petrochemical over alloy cluster. However, in existing situation, the alloy cluster has the least risk to be developed compared to the other clusters. This is due to two considerations. First, unlike bio-based and petrochemical cluster, alloy cluster products are difficult to be replaceable in its usage due to their chemical structure<sup>26</sup>. Second, currently Indonesia has shown strong economic growth which would translate into demand on construction materials. Most of these construction materials required alloy cluster products which is again, irreplaceable by petrochemical and bio-based cluster, such as steel and cement. Therefore PoRA team conducted a more detailed analysis on the market opportunity of both steel and cement plant as PoKT first industrial tenant.

The steel plant is considered to be the best “no-regret” client for PoKT. Because most of alloy industries such as ferro-alloys use steel as their feedstock. Also, steel plays an important role as construction material in buildings and manufacturing industry. There is also an opportunity to integrate the steel plant with the ship-breaking yard facility to make PoKT more commercially attractive and sustainable. However, currently there is a global oversupply of steel. Therefore to invest in a steel plant nowadays is not a commercially feasible decision. Steel plant might start to become attractive in the 2<sup>nd</sup> development of PoKT where the port has a more stable condition and the global market condition of steel might have improved.

The intention to have the cement plant as the 1<sup>st</sup> industrial tenant starts from making use of the existing alumina industry in Kuala Tanjung. Because alumina is used as a feedstock for the cement plant. As mentioned before, since currently Indonesia is experiencing strong economic growth, the consumption of cement per capita is also projected to be increased. Moreover, Semen Indonesia has stated their intention in building a cement plant in PoKT. In conclusion, the **PoRA experts prefer** to have either **cement plant** company (alloy cluster) or a **bio-ethanol plant** (bio-based cluster) as their first industrial tenant.

Besides selection of preferred cluster alternatives, other important topics affecting the success of PoKT 1<sup>st</sup> phase development have been discussed. These topics have at least one commercial attribute, however they are essential for PoKT to be developed and operated as envisioned. First is a discussion surrounding the construction of the breakwater. The breakwater is required for the container and breakbulk terminal based on Royal HaskoningDHV study. However, since there is no intention in building these terminals in the 1<sup>st</sup> phase, PoRA experts are in favour of postponing the construction of the breakwater. The discussion was then continued to ask the possibility of using the trestle structure as the foundation of the future breakwater to save space. The PoRA experts were then stated that as long as the solution proven to be cost-effective and viable they are willing to consider it. It is very important for them to have a robust layout which is not dependent towards an untested solution.

Second, is a discussion surrounding land availability, extending from land acquisition until land improvement. The PoRA experts have stated that, all studies that have been conducted on PoKT are being done under the assumption that the government would provide the land to the JV to exploit based on concession agreement. Therefore it is crucial to make sure that this assumption is still relevant in every stage of the PoKT project development.

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<sup>26</sup> Petrochemical and bio-based products can replace each other function, due to their similar chemical structure.

Finally, is a discussion surrounding the type of the electricity plant. Currently, there is two option for the type of the electricity plant, which is coal-fired and gas fired. To PoKT, the type of electricy plants would not significantly affects the port performance or cash flow. Nonetheless, it is beneficial to the JV as a port authority of PoKT to have an insightful decision when they allow the construction of the electricity plant. A Coal powered electricity plant has the advantage of cheap and vastly available fuel source, making it more reliable than the gas fired electricity plant. Coal fired power plant also generates dry bulk cargo flow which could be an additional source of income for PoKT. A gas fired electicity plant has more advantage in terms of sustainability due to its lower carbon footprint. However, a gas fired electricity plant would not generate additional cargo flow to PoKT, because Pertamina has stated that gas supply from the nearby gas field would be supplied to PoKT using pipelines if necessary. Therefore, judging from commercial perspective, the PoRA experts prefers coal fired electricity plant to be built in PoKT.

### 6.4.3 PoKT Robust 1<sup>st</sup> phase development: Researcher perspective

Embarking from the main intention in developing the PoKT, which is to support the “Tol Laut” network, the government would against the decision in investing in bio-based cluster. Because it would spark needless competition between two Indonesian strategic entity which supposed to be complementing each other to win against international competitors. Therefore, even though the bio-based cluster seems to be a promising idea, until a win-win solution between PoKT and Sei Mangkei is discovered, the JV is advised to delay the execution of the idea for awhile.

Whereas for the petrochemical cluster, as mentioned earlier existence of oil refineries or natural gas regasification field is paramount to attract potential petrochemical industrial tenants. Without these facilities, the industrial tenants would have more uncertainty in their feedstock supply. Depending on the importance of PoKT towards the Indonesian government in achieving their “World Maritime Axis” agenda, in theory, the government could have the steered the state-owned enterprises to work together cooperatively and make the 1st phase development of the port more feasible. For instance, the government could have advised Pertamina to build their refineries in PoKT. However, this assumption contains to many uncertainties as it contains significant amount of political lobbying. Therefore, it would be challenging to develop a petrochemical cluster in PoKT in a short-term.

That leaves us with the current most feasible option which is the alloy cluster. Based on the business case calculation, the cement plant is more profitable for PoKT compared to the steel plant. The difference between the cement and steel plant lies in the feedstock they require for production. The generated cargo throughput from having a cement plant is higher than that of a steel plant for the same available land slot, based on benchmark calculations. Semen Indonesia as a state-owned Portland cement company has also stated their interest in building cement plant in PoKT. Moreover, the existence of the alumnina plant owned by INALUM, provides a reliable feedstock supply for the cement plant. Based on these arguments, the cement plant clearly is the most viable option at this stage.

However for strategic reasons, it is advised for Indonesian government to invest in the steel plant. Because in order to support the “World Maritime Axis” agenda, Indonesia requires an increase in its commercial shipping fleet, which therefore would lead to increase in steel consumption demand. Being as one of widely used metals, steel also can be used for construction materials for railways and buildings. The existence of the steel plants is also essential to kick-start the circular economy concept in PoKT. The combination of the ship breaking yard with a steel plant would make the PoKT as the pioneer of a circular port industrial complex in the world.

By itself, constructing a ship breaking yard in the PoKT offers a promising opportunity. Stated in one of the densest cargo ship route, on average there is 222 vessels over 300 gross tonnage passed of Malacca strait per day in 2015 (Hand, 2016). Due to international regulations, all of these passing ships must be recycled once they have extended their service life. However, currently there are no internationally recognized ship breaking yard in the region, which turns into a perfect opportunity for PoKT. Nonetheless, there would be some roadblocks especially in terms of infrastructure. Because, usually ship breaking yard located in an area where there is a huge difference in tide range. Since PoKT only has around 3 m tide range, conventional ship breaking method would not be able to be implemented, which could mean an additional cost in CAPEX and OPEX of the shipbreaking yard. Nonetheless for a long-term cause, given that the government entities and the JV could work together into realizing a steel plant and ship breaking yard cluster, the PoKT would surely become one of the most advanced port in the world. In conclusion, **it is more preferable** for the PoKT to have either the **cement plant** (Alloy cluster) or **steel plant** (Alloy cluster) as the 1<sup>st</sup> industrial tenants.

Continuing to the other important topics surrounding the PoKT, the author would like to present his view as a researcher. First, a solution for the breakwater issue. Due to mild sea condition, the breakwater structure is only required as a shelter for the container terminal and breakbulk terminal. According to cargo forecast and market research, these two type of terminals has the lowest potential compared to the dry bulk and liquid bulk terminal. Moreover there is an existing MPT terminal nearby which could be used to handle the containers and the breakbulks. Therefore, the author agree with the PoRA experts that the construction for the breakwater in the PoKT 1<sup>st</sup> phase development is definitely postponable.

Nonetheless, in the future, the construction of a breakwater structure in PoKT is inevitable. Consequentially, the design of the 1<sup>st</sup> phase layout of PoKT must take into account the location of the breakwater and the container terminals. In the PoRA existing layout, they have designed a road to be constructed on top of a breakwater, making it also has a function of a trestle. Assuming the decision to postpone the construction of the breakwater had been taken, the construction of a modular trestle & breakwater should be conducted. Modular approach in civil engineering is not entirely new, however it is also still not commonly practiced. In theory, it is indeed possible to make a joint trestle and breakwater combi structure using a modular approach. This is theory would still need to be proven with a more detailed study. As a contingency plan, in case if this solution could not work, PoKT could simply build a breakwater next to the east side of the trestle to save materials for the construction.

As for the second topic, regarding the land related policy between the JV and the government. The author would like to stay neutral and trust the government and the JV to arrive in reasonable agreement for all shareholders. Finally, for the type of electricity plant. The author would like to promote the use of gas fired electricity plant. Not only that it is more sustainable, but it also attract future petrochemical industry which used natural gas as their feedstock. As a alternate solution for the decrease of cargo throughput due to the use of pipeline, the JV could simply charge the electricity plant using the utilities fee. The author believe that in a long-term, the use of gas fired electricity plant would certainly more beneficial than the coal fired powerplant. However, again a government support would be required to ensure reliable supply of gas from nearby or other Indonesian gas fields.

## 7 Conclusion and recommendations

To be able to answer the research questions stated in this report, a modified APP framework has been used. The main question is as follows:

*“How can an **adaptive** Port of Kuala Tanjung masterplan be designed together with its corresponding first phase layout and business case which **triggers** the Port of Kuala Tanjung first stage of construction works, while ensuring its **self-sustaining** capability and **catalyzing effect** with the next stages of the development?”*

As there is two expected product from the research, the APP framework has been modified into two parts<sup>27</sup>. One for the masterplan and one for the 1<sup>st</sup> phase layout. Whereas, the business case chapter is a section of the 1<sup>st</sup> phase layout part.

Next, to answer the main question, three sub-questions has been derived as follows:

1. What are the major future challenges confronting ports?
2. What will an adaptive Port of Kuala Tanjung masterplan look like?
3. How can the first phase development be robust and self sustainable, so that it attracts investors and triggers the construction works in practice?

The combined answer from the sub-questions above is the answer for the main research question.

### 7.1 Future challenges for ports (Sub-question 1)

Driven mainly by technological advancement (i.e: internet) and other developments driver, the world has become more connected than ever. This situation stimulated complex relationship between the drivers which results in the birth of new developments in various field. To be able to stay ahead of the competitions, ports must actively discover new opportunities and challenges resided beneath these developments. But first, the developments which is relevant for ports must be identified. Based on the research, developments which is relevant for the ports world wide has been identified as follows:

*Table 21 Developments affecting ports worldwide*

Level	Developments
Primary Developments (Direct effect of the developments driver, global developments)	Multi- national company partnerships
	Dynamics of International standards & organization
	Port Related Technology
Secondary Developments (Derivative of primary developments, continental developments)	Coalition of Shipping Lines
	Distinctive local regulation
	Dynamics of relevant government support
Tertiary Developments (Derivative of secondary developments, regional developments)	Dynamics of land acquisition process
	Relationship with neighbouring ports
	Special economic zone

<sup>27</sup> Please refer to section 1.5 for further information regarding the thesis framework

To be able to know the future challenges for ports, Table 21 can be used as a “to be analyzed” list to identify the challenges systematically. During the research, it is concluded that a generalization of future challenges for ports world-wide is not feasible. Because, every ports are subject to different geographic and geo-politic challenges. Moreover, the challenges that a port faced always evolves depending on the stage of the development. A generalization for identified challenges could only be done for a group of ports which shared common attributes. For instance, the identified future challenges for PoKT is valid for ports which has attribute as follows:

- A green-field port which is developed by a joint venture company
- The port is located in a sizeable **non** continental hinterland with population of ~60 million people
- Identified during the planning stage of the project

As for PoKT itself, in the current stage, the main future challenges it face are originated from the developments as follows:

- Multi-national company partnerships: The JV (Pelindo 1 and PoRA) needs to figure out how to establish a company framework which could bring the best of both parties.
- Dynamics of relevant government support: The support of Indonesian government is very important for PoKT for processing the permits, procuring the land, and provide financial support to ease the financial burden
- Relationship with neighbouring ports: The relationship with nearby Indonesian port, Port of Belawan need to be agreed as soon as possible. Ideally, PoKT should have a complementary relationship with Port of Belawan. Strategies needs to be developed to face competition with Port of Singapore and Port of Klang in the future.
- Special economic zone: The relationship with Sei Mangkei should be managed carefully. Direct competition should be avoided at all cost and each party should find away to strengthen each other. For instance, PoKT could focus on handling cargo generated by Sei Mangkei, while Sei Mangkei could focus on producing palm-oil based products.
- Port related technology: In the current stage, PoKT should focus on finding technologies which could result in a more positive business case. This is could be done by reducing the construction cost or delaying it. In the future, the technology should be more focused on optimizing the port system to generate more income or reduce OPEX.

The identified challenges for PoKT is being used as a reference for the definition of success in developing PoKT masterplan and 1<sup>st</sup> phase layout.

## 7.2 PoKT Masterplan (Sub-question 2)

An adaptive PoKT Masterplan would have an adaptivity attribute embedded in its three management layer. In order to do so, the first part of APP framework has been dedicated to develop an adaptive PoKT masterplan. First, the “opportunities or vulnerabilities” have been identified in the PoKT *physical infrastructure, operational and management, and product and service* layer. Next, the PoKT adaptability have been increased by using the applicable four different type of action (Shaping, Seizing, Hedging, or Mitigating) on the identified “opportunities or vulnerabilities”. The actual type of actions that are being used for each “opportunities or vulnerabilities” depends on their suitability with the respective “opportunities or vulnerabilities”. By analyzing the possible improvements on each management layer of PoKT, the adaptability of the Port have been improved comprehensively.

In terms of the layout, an adaptive PoKT Masterplan should be able to adjust accordingly depending on the realization of each stage of development. Therefore, in every stage of development, alternatives of the Port masterplan should be developed based on the most sensitive assumption on the current layout planning. For instance, in the case of the PoKT, the most sensitive assumption in the 1<sup>st</sup> phase layout development, is the type of the 1<sup>st</sup> industrial tenant. Therefore three alternative types of masterplan has been developed accordingly. For a complete set of actions available for three management layer in PoKT, please refer to Table 9. While for the drawing of three PoKT masterplan layout, please refer to Appendix A.

### 7.3 PoKT 1<sup>st</sup> phase development (Sub-question 3)

The study on PoKT 1<sup>st</sup> phase development is conducted in the second part of the APP framework. To answer the third sub-question, a circular economic model of a port industrial complex has been developed. This model is discovered during the analysis on “opportunities or vulnerabilities” in chapter 3. By applying the circular economic model in PoKT, the port would have generate capabilities as follows:

- More stable cargo flow due to the import of feedstocks and export of cargos generated by the industrial tenants in the port cluster (increased self-sustainability)
- Attract future industrial tenants due to the benefit of sharing facilities with existing tenants which therefore saves them cost to develop their own infrastructure and the opportunity to use the product of exisiting industry as a feedstock for their own production (increased catalyzingeffect)

The total effect of the points above has contributed to increase the robustness of PoKT 1<sup>st</sup> phase development. In the second part of the study, plans for the 1<sup>st</sup> phase development of the PoKT has been developed. This plan consisted of layout, business case, and added value analysis.

First, a port layout for the 1<sup>st</sup> phase development has been drafted. There are three developed port layouts which are an Alloy, Bio-based, and Petrochemical cluster layout. These port layouts is developed based on the circular economic model which is discovered as one of solutions for the vulnerabilities in the PoKT masterplan *physical infrastructure layer*. By taking into account all available information and assumptions, each alternatives of PoKT 1<sup>st</sup> phase layout should consist of:

- Either dry or liquid bulk terminal
- A trestle and a jetty
- Electricity plant
- Storage yard (for coal or petrochemicals)
- Land slot for industrial cluster
- Main corridors (Roads, pipelines, or railways) and utilities (Water and sewage system)

Next each layout alternatives were evaluated by using a business case calculation and added value analysis. From these evaluations it is concluded that Alloy cluster is the best alternative layout in current condition, in terms of its financial performance and robustness. As for the 1<sup>st</sup> industrial tenant for the alloy cluster, it is preferable to have the cement plant over the steel plant for commercial reason. However, for a long-term benefit in PoKT and Indonesia as a whole, the author would like to promote the constructuion of the steel plant. Nonetheless, strong Indonesian government support is required to make it happen. For more information regarding the evaluation and case study of the layouts please refer to chapter 5 and 6 respectively.

## 7.4 Concluding remark

By applying the adaptive port planning framework, an adaptive masterplan and robust 1st phase layout of the PoKT has been developed based on the existing layouts. These improved layouts were designed to be functional under various future scenarios, by taking into account the *nine principal uncertainties*<sup>28</sup> affecting the ports worldwide. It is obvious that the construction of container and breakbulk terminal should be done in the 1st phase, as it would result in a redundant design due to the existence of the MPT located nearby the 1st phase construction site. It is recommended to postpone the construction of these two terminals as late as possible to ease the port financial burden. Because, to construct the container and breakbulk terminal, an expensive breakwater would be required. The construction of these two terminals should also be conducted only when the PoKT has achieved sufficient infrastructure and financial maturity to face the competition with Port of Klang and Port of Singapore directly.

To ensure the PoKT remain ahead of its competitors, a different approach must be adopted. It should be noted that Port of Klang and Port of Singapore are world class ports that are placed on top 15 based on its cargo throughput. Moreover, the nine developments affecting ports worldwide would introduce new challenges and opportunities for all ports in Malacca Strait, including PoKT. A conventional port strategy would only bring PoKT into the Port of Klang and the Port of Singapore footsteps. A new strategy would be required to even the competition field. This new strategy was introduced in this study in a form a circular economy based port industrial cluster model. The cargo flow that is generated by creating industrial activities within the port would result in a stable throughput in the PoKT. Moreover, the industrial activities would generate significant direct and indirect jobs as well as added value to the surrounding region. To identify and stimulate added values that are generated by the PoKT, the UN-SDG number 8 (decent work and economic growth), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), 14 and 15 (life below water and on land), has been referred as a filter. By adopting this model, the PoKT would have a distinct advantage over its competitors. Based on the assessments which are done in the previous sections, an Alloy cluster in the form of cement plant would be the best alternative to be constructed in the PoKT 1st phase development. A dry bulk terminal, electricity plant, roads, and utilities should also be constructed as the minimum required infrastructures for the PoKT to be operational.

However, even in the best possible scenario, the 1st phase development of PoKT would not be commercially feasible in itself without external support. Even by postponing the construction of the breakwater, the net present value (NPV) of the project is still estimated to be – 70.16 Million USD in the best case scenario. This number is already an improvement by 48 % from the previous NPV which is estimated to be – 136 Million USD. The negative NPV implies that the PoKT project could not be classified as a “profitable” project for a long-term investment. In its current financial state, the PoKT would not be able to attract private investors without providing strategic offerings for the potential investors. Another option to improve the PoKT financial feasibility would be to request for government support. Since this project is listed under Indonesia’s National Strategic project, a government support would ideally be expected to be given to the project. The expected support should come regarding both permits and financials assistance of the project. The exact form of support should be discussed in more detail between the JV and the responsible ministries (Ministry of transport, state-owned enterprise, industry, and fund). Its form may come in either capital injection, grants, taxation, contract offtakes or another type of supports.

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<sup>28</sup> Please refer to subsection 2.2 for more information

## 7.5 Recommendations

In this research, numerous research topics have been identified which needs to be studied further. However due to the constraint of time and resources, the analysis has been limited to preliminary level. List of topics which needs to be studied further and their relevance towards PoKT are listed as follows:

*Table 22 Recommendation for further studies*

Field	Subject	Objective
Engineering	Basic design on trestle and breakwater combi structure	Feasibility study about the modular structure
	Basic design for multipurpose SPAR design	SPAR structure could possibly be used as a replacement for the jetty to save cost. However, further study needs to be conducted to discover the possibility of a multipurpose SPAR (oil, gas, palm oil and other liquid)
	Sediment transport analysis	Finding sedimentation pattern and rate
	Vessel traffic modelling	Optimizing quay length and waiting time
	River diversion study	Research on the cost and long-term effect of the river diversion
	Basic design using the new layout	To make the CAPEX calculation more accurate as an input for the business case
	Comparison on offshore vs onshore terminal concept	Since PoKT located on soft soil, a container terminal build on top a reclaimed land would be very expensive. It might be worthwhile to compare it with offshore terminal alternative
Economy/ finance	Project financing scheme	Detailed financing scheme options for the 1st phase of PoKT development and its implications
	Pricing strategies	A study dedicated to optimize income which could be received by PoKT
	Long-term strategy against neighbouring ports	A research to discover options for PoKT to win against its competitor while supporting Indonesian ports
Management	Detailed stakeholder management	Since there are vast amount of stakeholder is being affected by PoKT, it might be usefull to study in detail how to manage relationship with each stakeholer and benefit each other.
	Strategies for the Joint venture co-operations	Dedicated study to strengthen the bond between Pelindo 1 and PoRA. It should be used internally
Legal	Indonesian law review	Make sure the existing indonesia legal framework allows the plan developed for PoKT to be executed
General	Backward and forward linkages analysis	A more detailed analysis on added values created by PoKT
	Port of Kuala Tanjung Blue Book	Integrating all previous studies about PoKT and make it as practical as possible

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